ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 1-6, 2019
doi: 10.5281/zenodo.2620772

A new species of *Allacta* Saussure & Zehntner 1895 (Blattodea: Ectobiidae: Pseudophyllodromiinae) from India

***S. Prabakaran[1], M. Senraj[2] and Cristian C. Lucanas[3]**

[1] *Freshwater Biology Regional Centre, Zoological Survey of India, Hyderabad - 500 048, India.*
[2] *Southern Regional Centre, Zoological Survey of India, Chennai - 600 028, India.*
[3] *Museum of Natural History, University of Philippines Los Banos, Laguna, Philippines.*

(Email: prabakaranzsi@yahoo.co.in)

Abstract

A new species of *Allacta* Saussure & Zehntner, 1895, *A. kalakadensis* sp. n. is described and assigned to -*hamifera* species group. It differs from other known members of the –*hamifera* species group by the sexual wing dimorphism, pronotal and facial markings, and the structure of the male genitalia.

Keywords: *Allacta kalakadensis; Cockroach; Diversity; Western Ghats; Wing dimorphism.*

Received: 28 December 2018; Revised: 8 April 2019; Online: 9 April 2019.

Introduction

The Western Ghats of India is considered as a biodiversity hotspot, a region with high species richness with high percent endemicity, but with alarming degrees of threat (Myers, 1988; Bossuyt *et al*., 2004). Depite such high species richness, only 26 of 170 known Indian cockroach species are reported from Western Ghats, mainly from Karnataka (19 species; Prabakaran, 2010) and Tamil Nadu (7 species; Beccalloni, 2014). Recent collection trips to the Western Ghats have resulted in an array of cockroach specimens, including an undescribed species of *Allacta* Saussure & Zehntner, 1895.

The genus *Allacta* is differentiated from other Pseudophyllodromiinae mainly by the presence of pulvilli being only on the fourth tarsomere of all legs (Roth, 1993). Currently, it contains 42 species distributed in Tropical Asia and Australasia (Beccaloni, 2014). Despite the high diversity of the Western Ghats and the high number of *Allacta* species, Prabakaran and Senraj (2018), only recorded three species in India: *Allacta crassivenosa* Bolivar, 1897 [placed as *incertae sedis* by Roth, 1993], *Allacta diluta* (Saussure, 1863) and *Allacta figurata* (Walker, 1871). Here, a new species *Allacta kalakadensis* **sp. n.**, is described from Tamil Nadu.

Materials and Methods

The material for the present study are based on recent collections from Kalakkad-Mundanthurai survey of the Southern Regional Centre, Zoological Survey of India and specimens collected during night survey at Valaiyathu odai, Thirukurungudi Range, Tamil Nadu. Specimens collected from light trap and the bark of *Tamarindus indicus* were preserved in 90% ethyl alcohol. Genital segments were dissected and mounted on the permanent slide as described in Lucañas and Lit (2016).

Terminologies used for male genitalia follow Klass (1997), Li *et al*. (2018) for wing venations and Roth (2003) for other characters. The measurements and photographs were taken by Leica EZ4E Stereozoom Microscope. Illustrations were made using Inkscape 0.92.3. The specimens used in this study are deposited in the collections of the Southern Regional Centre, Zoological Survey of India, Chennai.

Taxonomy

Superfamily Blaberoidea
Family "Ectobiidae"
Subfamily Pseudophyllodromiinae
Genus *Allacta* Saussure and Zehntner, 1895

Allacta Saussure & Zehntner, 1895: 45 (Type species: *Abrodiaeta modesta* Brunner von Wattenwyl, 1893 by selection); Roth, 1991: 996; 1993: 361; 1995: 51; 1996: 235.

Abrodiaeta Brunner von Wattenwyl, 1893: 13 (Types pecies: *Abrodiaeta modesta* Brunner von Wattenwyl by selection)

Pseudochorisoblatta Bruijning, 1948: 90 (Type species: *Phyllodromia interrupta* Hanitsch, by selection.); Princis, 1965: 151.
Arublatta Bruijning, 1947: 224 (Type species: *Blatta punctata* Walker, 1869 = *Arublatta basivittata* Bruijning, by monotypy.); Roth, 1991: 996.
Compsosilpha Princis, 1950: 178 (Type species: *Chorisoblatta karnyi* Hanitsch, 1923 by monotypy); Roth, 1996: 235.
Euhanitschia Princis, 1950: 180 (Type species: *Phyllodromia diagrammatica* Hanitsch by monotypy); Roth, 1996: 235.

Diagnosis: Roth (1993; 1995) described the genus as follows: tegmina and wings fully developed or reduced in females as in (*Allacta persoonsi* Roth, 1995 and *Allacta nalepae* Roth, 1995). Hind wing with radial vein straight, apical triangle small or absent. Front femur Type B_2 or B_3. Pulvilli present only on the fourth tarsomere of all legs. Tarsal claws simple, symmetrical. Arolia present. Male genitalia with four major phallomeres; hook-like phallomere (L3) on the right side placing it under Pseudophyllodromiinae. In females, ootheca not rotated prior to deposition.

The bifurcate L2, setal brushes on L2d, presence of median accessory phallomere, as well as the shape of the subgenital plate suggests its close relation to *Sundablatta* Hebard, 1929 and *Pseudophyllodromia* Brunner von Wattenwyl, 1865 (Roth, 1996), as well as, *Tagaloblatta* Lucañas, 2016. It differs from the said genera by the combination of the following characters: by the presence of pulvilli only on the fourth tarsomere of all legs (present on all tarsomeres in *Pseudophyllodromia*, while absent in *Tagaloblatta*), and fore femur type B (type C in *Sundablatta*).

Vrsansky *et al.* (2011) insisted on the close relationship between *Allacta* and *Supella* Shelford, 1911, based only on external morphology (especially on the coloration of *Supella* (*Nemosupella*) and some *hamifera* – species group). Despite that, the internal male genitalia of *Supella* (as illustrated in McKittrick, 1964 and Roth, 1999): with simple and relatively elongate L2, distinctly separated L2d and L2vm, long elongate L3, and lacking median accessory phallomere, and the presence of a setose gland on the abdominal tergite 7, suggests a distant relationship between *Supella* and *Allacta*.

Distribution: Australasia (Papua New Guinea and Queensland); Tropical Asia (Beccaloni, 2014).

Species *incertae sedis* *crassivenosa* (Bolivar, 1897)

Described by Bolivar (1897) as *Ceratinoptera* (*Allacta*) *crassivenosa* based on a specimen from Kodaikanal, Tamil Nadu, India. Roth (1993) questioned the placement of this species in *Allacta* on the basis that Bolivar (1897) suggested that it is closely related to *A. brachyptera* Saussure & Zehntner and *A. abbreviata* Saussure & Zehntner, which are now placed in *Anallacta* Shelford (Blattellinae). Meanwhile, Wang *et al.* (2014) listed 41 species in this genus, including *crassivenosa.*

Upon examination of the photographs of the syntype in the Muséum National D'Histoire Naturelle, Paris website, the following characters were observed: Fore femur type C2, pulvilli present on all tarsomeres, and subgenital plate symmetrical or weakly asymmetrical. These characters clearly suggest that the species is not *Allacta* and is closer to either *Balta* Tepper or *Supellina* Bohn (Pseudophyllodromiinae). Closer inspection of the type specimen, particularly the structure of the tarsal claws and male genitalia, is needed to confirm this placement of this species.

-*hamifera* species group

Diagnosis: Roth (1993) described the –*hamifera* species group as follows: Pronotum dark with white or colourless lateral borders and or with pale central macula. Male interstylar margin V-shaped or incise with a lobe formed in the tip it appears keel like ridges found on the subgenital plate.

Remarks: Except for *A. crassivenosa*, Roth (1993) placed all of the known Indian *Allacta* sp. in the *–hamifera* species group.

***Allacta kalakadensis* Prabakaran & Senraj sp. n.**
(Figures 1 A- J)

urn:lsid:zoobank.org:act:0CE7F1B1-C79E-4CB1-84A5-2EE10A0524DF

Material examined: HOLOTYPE: 1 male, INDIA, Tamil Nadu, Thirukurungudi Range, Valaiyathu odai. (08.41078'N; 77.55662'E) 142.2m, 24/09/2018. Coll. R. Venkitesan & Party, collected in Light trap. (Reg. No. IB-542). PARATYPES, 3 males, 1 female, same location

data as Holotype. Zoological Survey of India, Southern Regional Centre, Chennai, Tamil Nadu, India (Reg. Nos. IB-543,544,545,546).

Diagnosis: The combination of the following characters separate the new species from all other known *Allacta –hamifera* species group: sexually dimorphic: males macropterous; females brachypterous, tegmina reaching up to the fourth abdominal segment. Vertex exposed. Pronotum subparabolic, with large pale central macula surrounded by brown borders, margin hyaline. Tegmina with a pair of brown macula. Profemur Type B_3. Pulvilli present only on the fourth tarsomere of all legs. Tarsal claws simple, symmetrical. Supraanal plate transverse and narrow; paraprocts simple and symmetrical. Subgenital plate weakly asymmetrical; with weak posterio-median invagination; styles simple, similar. Hook-like phallomere (L3) on the right side; median phallomere (L2) bifurcate, with setal brushes; accessory median phallomere present.

On the basis of coloration and interstylar invagination, *A. kalakadensis* **sp. n.** is placed on the *–hamifera* species group. This species closely resembles to *A. interrupta* (Hanitsch, 1925) and *A. svensonorum* Roth, 1995 from Borneo, *A. figurata* (Walker, 1871) and *A. diluta* from India, which all can be separated by difference in the head markings (*A. interrupta* with occiput pale, vertex with dark brown maculae which divides into two narrowing longitudinal stripes that joins medially at the level of the antennal socket; *A. svensonorum*: head yellowish, with occiput and vertex dark brown with weak dark areas near gena and compound eyes; *A. figurata*: head yellowish brown, with occiput pale, vertex dark brown, with two longitudinal brown stripes separated by a narrow pale stripe reaching below the level of the antennal socket, weak dark areas near gena; *A. diluta:* face brownish, vertex brown; *A. kalakadensis:* face yellowish, occiput dark brown, vertex dark brown forming two longitudinal brown stripes ending just above the antennal socket and three dark spots between the antennal sockets, clypeus with dark marginal macula) and tegminal markings (*A. interrupta*, each with a pair of brownish maculae; *A. svensonorum*, hyaline reddish brown without distinct markings; *A. figurata*, each with a pair of reddish brown macula, the basal darker than the distad; *A. diluta*, each with a pair of brown elongated maculae fused in borders; *A. kalakadensis*, each with two distinctly separated large macula).

It further differs from the Bornean species by the structure of the male genitalia. Unfortunately, the male of *A. diluta* and the male genitalia of *A. figurata* have not been described, which Princis treated as synonyms. It differs from the female *A. diluta* in term of wing size (macropterous in *A. diluta* female, but *brachypterous* in *A. kalakadensis* **sp. n.**), meanwhile it differs from *A. figurata* in terms of the pronotal (*A. kalakadensis* with larger pale central macula and thinner brown border than *A. figurata*) and facial markings (with two longitudinal brown stripes separated by a narrow pale stripe reaching below the level of the antennal socket in *A. figurata*, while vertex dark brown forming two longitudinal brown stripes ending just above the antennal socket and three dark spots between the antennal sockets, clypeus with dark marginal macula in *A. kalakadensis*).

Description: *Size* (mm): Male: overall length: 11.0 - 11.6; tegmen: 8.4 – 9.1; pronotum: length x width: 2.1 - 2.3 x 2.7 - 3.1. Female: overall length: 9.2; tegmen: 3.7; pronotum: length x width: 2.2 x 3.0.

Male (Fig. 1A)*:* The interocular distance less than interantennal distance. Ocellar spots located above in the antennal socket. Head (Fig.1C) with brown dark patches from vertex to just above the antennal socket, with a medial, longitudinal light stripe completely connecting the dark patches up; the longitudinal light stripe with three separate dark dots; inner posterio-lateral corners of eyes, anterior margin and posterio-lateral corner of clypeus dark brown. 5^{th} maxillary palpi enlarged, slightly shorter than 4^{th} palpi.

Pronotum subparabolic in shape, with large pale central macula with dark brown border that reaches from anterior region to posterior region; pronotal margin hyaline. Front femur (Fig.1E) Type B_3: 5-6 proximal stout spines succeeded by a row of pilliform spinules of uniform length and terminating in 3 large spines increasing in size distally. Pulvilli present only on the 4^{th} tarsomere of legs. All, except 4^{th} tarsomere, with two equal rows of spines laterally. Tarsal claws simple and symmetrical; arolia present. Tegmina and hindwings fully developed, extending beyond the end of the abdomen; in the resting position hind wing goes beyond the tegmen. Tegmina (Fig. 1F) yellowish brown and hyaline, with pair of small dark macula and the anal field also covered by dark marking; mediocubital (M) longitudinal; claval branches (CuA) few, reaching the apical margin and remaining oblique.

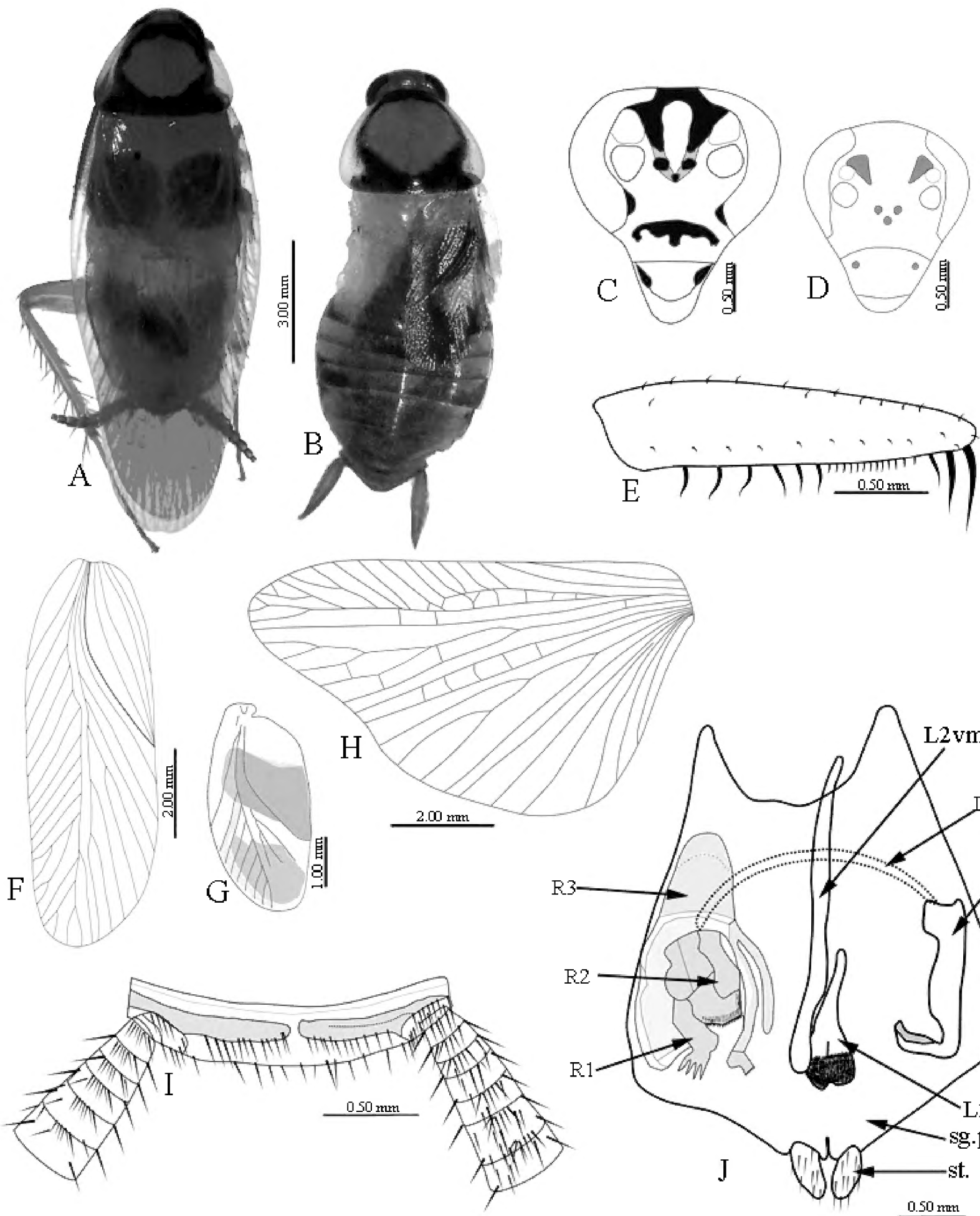

Figure 1. *Allacta kalakadensis* **sp. n.**: Habitus of male (**A**) and female (**B**). Head of male (**C**) and female (**D**); profemur (**E**); tegmina of male (**F**) and female (**G**); hindwing of male (**H**); supra-anal plate (**I**); subgenital plate and genitalia (**J**). Acronyms: sg.p. – subgenital plate; st. – style; R1, R2, R3 – Right phallomere sclerites; L2d, L2vm – median phallomere sclerites; L3 – hook-like phallomere; L4 – accessory median phallomere.

Hind wing (Fig.1H) with costal and subcostal veins clubbed with cross veins; radial veins branched after middle part of the wing, with 3 complete branches; the median vein straight and unbranched; cubitus vein curved with 4 complete branches. Abdominal terga unspecialized. Supraanal plate (Fig.1I) transverse, rectangular; paraprocts simple, similar. Cerci yellowish brown, darkens towards apex. Subgenital plate (Fig.1J) symmetrical with a pair of small bulbous and similar small styles directed towards the midline to the interstylar margin; interstylar

margin extended ventrad forming a keel-like ridge. Genital hook (L3) medium sized located in the right side with a preapical incision, the median phallomere (L2vm) with greatly modified apex, with a curved sclerite (L2d) and lie under the median phallomere in the apex. The left phallomere have several irregular setal brushes with sclerites in the centre, in the apical part end with 4 spikes (R1). The accessory median phallomere (L4) lies below the median phallomere, left phallomere, and genital hook.

Female (Fig.1B): Similar to male except: head with dark patches extending from vertex and ending in ocellar spot and frons with three mild yellowish black spot (Fig.1D); tegmina reduced (Fig.1G), reaching only up to 4th abdominal segment; hind wing very small; posterio-lateral corners of 3rd, 4th and 5th abdominal segments with yellowish markings; cerci yellowish brown, darkening towards the apex.

Etymology: named after the type locality: Kalakad Mundanthurai Tiger Reserve Area, Tamil Nadu, India.

Known Distribution: INDIA: Tamil Nadu.

Remarks: Due to the distinct pattern difference between the male and female, it may be possible that they are two separate species, despite that, they are considered the same here on the premise that both were collected from the same tree. Additional samples would enable to check the color variations between sexes and additional molecular information might be needed to clarify this.

Acknowledgements

Thanks are due to the Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata and the Officer in Charges, Southern Regional Centre & Freshwater Biology Regional Centre, ZSI, Chennai and Hyderabad for providing the necessary facilities. Authors are also thankful to Dr R. Venkitesan Scientist-D Zoological Survey of India, Southern Regional Centre, Chennai for collecting and providing the specimens.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)

HALTERES, Volume 10, 7-18, 2019
doi: 10.5281/zenodo.2633828

Altica himalayensis (Chen), an emerging pest of temperate horticultural crops from Kashmir valley

G. Mahendiran[1], Mudasir Ahmad Dar[2] and Shahid Ali Akbar[2*]

[1]*Division of Germplasm collection and Characterisation, ICAR-National Bureau of Agricultural Insect Resources, P.B. No. 2491, H.A. Farm Post, Hebbal, Bellary Road, Bengaluru-560024, India.*
[2]*Department of Entomology, Central Institute of Temperate Horticulture, Srinagar-191132, Jammu and Kashmir, India.*

(Email: kingakbarali@gmail.com)

Abstract

Seasonality, host range, and biology of *Altica himalayensis* Chen are detailed. The species is one of the most dominant leaf beetle (Chrysomelidae: Coleoptera) found in the Kashmir valley. A major pest of *Rumex nepalensis* (locally known as *Abuji*), plant is used as a source of food, astringent qualities, and for dyeing purposes. During the present study the pest was also found to feed on *Polygonium aviculare* (new host plant) and adults were also found to exert considerable damage to a number of other major crops including, apricot, almond, apple, strawberry, and walnut. Updated checklist and taxonomic status of the genus *Altica* from India is also provided herewith.

Keywords: *Altica himalayensis, Polygonium aviculare, pest, biology, Kashmir.*

Received: 17 February 2018; Revised: 4 April 2019; Online: 11 April 2019.

Introduction

The family Chrysomelidae is one of the larger families of Coleoptera with more than 50,000 described species (LeSage, 1991). These insects are also known as flea beetles and constitute one of the most destructive phytophagous pests of agricultural plants (Kimoto, 2005; Aslan *et al.,* 2007). Within chrysomelids *Altica* represents a large genus with more than 300 described species worldwide (Reid and Beatson, 2015). These beetles have gained prominence for their role as beneficial in the biological control of noxious weeds and as a severe economic pest of crop plants (Aslan *et al*., 1999; Warchalowski, 2003). They occur in huge numbers, altering plant succession in dynamic habitats (Bach, 1994). Most of the species are small, metallic blue-green-bronze and similar to each other, with very few reliable external distinguishing morphological features. Male genitalic structure, aedeagus is the most reliable character for species delimitation. The exact number of described species still remains controversial. Presence of parthenogenetic populations and similar host plants cause considerable difficulty in defining the species limits (Laroche *et al.,* 1996; Jenkins *et al.,* 2009; Döberl, 2010; Xue *et al.,* 2011). The range of host plants of *Altica* species worldwide is enormous (Jolivet, 1991; Clark *et al.,* 2004); five primary host plant families (Onagraceae, Rosaceae, Ericaceae, Corylaceae, Cornaceae) for Holarctic species of *Altica* have been reported (Furth, 1980).

One of the most dominant Chrysomelid species from Kashmir valley; *A. himalayensis* is detailed here. Zeya *et al.* (2003), Nasim and Shabbir (2012) and Bhat (2017a, b) have previously reported *A. himalayensis* as a major pest of *R. nepaliensis* (*acetosa*?)and prominent biocontrol agent against Himalayan balsam (*Impatiens glandulifera*). However, during the present study the beetle was observed as an emerging pest of horticultural crops from the Kashmir valley. The pest infest broad spectrum

of temperate horticultural crops including apple, peach, cherry, apricot, almond, strawberry in addition to number of other previously reported host plants. The seasonality, biology and taxonomic status of the pest are detailed here.

Materials and Methods

Periodic monitoring of the pest was carried in orchards of Central Institute of Temperate Horticulture (CITH) during the years, 2014–2016. CITH is situated at 33.59°N latitude and 74.50°E longitude at an altitude of 1640m asl. Specimens were collected by hand picking method. Weekly observations on the pest population were recorded using standard UC IPM, sampling protocols. Immature stages (eggs, larvae, and pupae) were collected and reared in biosystematics laboratory of CITH for studies on biology of the pest. Larvae along with their host plant parts, infesting leaves, flowers and buds were reared at room temperatures (18°C–32°C). For digital images, Prog-Res-Capture Pro v.2.8.0 evolution digital camera was used on the same microscope with Combine ZP-Montage software. Later, images were cleaned with Adobe Photoshop CS6. List of abbreviations and depositories are: TL: Type Locality; TD: Type Depository; NA: Not available.

BMH: Bishop Museum, Hawai'i; **BMNH:** British Museum of Natural History; **MCZ:** Museum of Comparative Zoology, Harvard; **SAM:** Royal South Australian Museum, Adelaide; **NMSE:** National Museum of Scotland, Edinburgh.

Results

Systematics

Genus *Altica* was established by *Geoffrroy in 1762 for the type species *Chrysomela oleracea* Linneus (1758) and adopted by subsequent designations (Clark *et al.,* 2004; Doberl, 2010). As per Furth (1981) the genus name must be attributed to Fabricius (1775). The genus *Altica* is represented by nine species from India (Konstantinov and Vandenberg, 1996; Medvedev, 2004; Kimoto, 2005; Zhang *et al.,* 2006; Döeberl, 2010; Reid and Beatson, 2015). The updated checklist of the Indian species of the genus *Altica* is provided.

Genus *Altica* Geoffroy, 1762

Altica aenea (Olivier, 1808)

Galeruca aenea Olivier, 1808: 646; TL: Java; TD: BMH, SAM

Taxonomic history: *Haltica aenea*: Heikertinger and Csiki, 1939: 247 (as synonym of *A. cyanea* sensu auctt.); *Altica aenea*: Gressitt and Kimoto, 1963: 890 (as synonym of *A. cyanea* sensu auctt.); *Haltica australis* Blackburn, 1889: 1493; Weise, 1923: 109 (synonym of *A. cyanea* sensu auctt.); *Altica australis*: Gressitt and Kimoto, 1963: 890 (as synonym of *A. cyanea* sensu auctt.); Scherer, 1982: 480 (valid species); *Haltica ignea* Blackburn, 1889: 1494 (type locality: Northern Territory); Reid and Beaton, 2015; *Haltica bicolora* Jacoby 1904: 182 (type locality: southeast New Guinea) Reid and Beaton, 2015; *Altica jussiaeae* Gressitt 1955: 34 (type locality: Palau) Reid and Beaton, 2015; *Altica caerulea* sensu Weise, 1923, nec Olivier 1791; Weise, 1923: 109; *Altica cyanea* sensu auctt. nec Weber, 1801; Maulik, 1926: 422; *Altica corrusca* sensu auctt. nec Erichson, 1842; Bryant and Gressitt, 1957.

Distribution in India: Jhansi-Chatarpur, Rishikesh (Reid and Beaton, 2015).

General distribution: Tropical Australia, Southeast Asia, West Pacific Islands of Palau, Fiji, New Caledonia and Vanuatu, New Guinea, Sri Lanka, Andaman Islands, (Gruev and Döberl, 2005).

Altica birmanensis (Jacoby, 1896)

Haltica birmanensis Jacoby, 1896: 254; TL: Burma; TD: MCZ, BMNH

Taxonomic history: Maulik 1926: 422 (junior synonym of *A. cyanea*); *Altica birmanensis*: Gressitt & Kimoto, 1963: 890 (as junior synonym of *A. cyanea*); Takizawa, 1978: 78 (valid species, as *A. birmensis*); Medvedev, 2009: 24 (junior synonym of *A. cyanea*); *Altica birmaensis* [misspelling]: Scherer, 1969: 129 (as junior synonym of *A. cyanea*); *Altica birmensis* [misspelling]: Kimoto, 1972: 38; *Haltica indica*

Shukla, 1960: 80 (type locality India, Reid and Beaton, 2015)

Distribution in India: Sikkim, Eastern Himalayas (Kimoto, 1967).

General distribution: Vietnam, Taiwan, Timor, New Guinea (Reid and Beaton, 2015).

Altica bicosta Shukla, 1960

Altica bicosta Shukla, 1960: NA; TL: NA; TD: NA

Taxonomic history: The species was synonymised with *A. brevicosta* by Scherer (1969), however was recently advocated as valid species by (Reid and Beaton, 2015).

Remarks: Illustration of the dorsal view of the penis suggests that this may be a different species, not *A. brevicosta* (*A. caerulea*). As such Reid and Beaton (2015) have removed *A. bicosta* from synonymy with *A. brevicosta* and *A. caerulea* and suggest it be treated as a valid species. The species is so far reported only from Northwest India (Reid and Beaton, 2015)

Altica caerulea (Olivier 1791)

Galeruca caerulea Olivier 1791: 590; TL: East Indies; TD: NMSE

Taxonomic history: *Graptodera coerulea* [misspelling]: Allard, 1891: 230; *Haltica coerulea* [misspelling]: Maulik, 1926: 423; *Altica coerulea* [misspelling]: Gressitt & Kimoto, 1963: 890 (misidentification, as junior synonym of *A. cyanea*); Kimoto, 1966: 35 (valid species); *Altica coelurea* [misspelling]: Kimoto, 1972: 47; *Haltica elongata* Jacoby, 1884: 28 (type locality: Sumatra); Reid and Beaton, 2015; *Altica elongata*: Kimoto, 2001: 159; *Altica brevicosta* Weise, 1922: 110 (type locality: Luzon, Java, Canton, Darjeeling); Kimoto, 1972: 47 (jun. syn. *A. caerulea*); Medvedev, 2009: 22 (valid species); Döberl, 2010: 493 (jun. syn. *A. caerulea*); *Altica brevicostata* [misspelling]: Kimoto,1965: 490; *Haltica brevicosta*: Chen, 1933: 51(see Reid and Beaton, 2015).

Distribution in India: Northwest Punjab, Mysore, Himalayas (Kimoto, 1967).

General distribution: Burma, China (Chekiang, Hainan I., Kwangtung), Indonesia (Borneo, Java, Sumatra), Korea, Laos, Peninsular Malaysia, Nepal, Pakistan, Philippines (Luzon), Sri Lanka, Taiwan, Thailand, Vietnam (Gruev and Döberl, 2005).

Altica foveicollis (Jacoby, 1889)

Altica foveicollis Jacoby, 1889: NA; TL: NA; TD: BMNH

Taxonomic history: The species was treated as synonym of *A. aenea* (as *A. cyanea*) by Döberl (2010). However Reid and Beaton (2015) advocate it as a valid species.

Remarks: Photographs of a syntype show that *A. foveicollis* is densely microsculptured, with costate and finely punctured elytra and the male genitalia illustrated by Scherer (1969: 130), and different host plants suggest the species to be distinct from *A. aenea* (Reid and Beaton, 2015). Hence is here treated as valid species. The paper of Jacoby (1889) is not available for any further remarks about the about.

Distribution in India: Sikkim, Himalaya (Kimoto, 1967)

General distribution: Kotbari (Pakistan), Comilla, Dhaka (Bangladesh) (Gruev & Döberl, 2005)

Altica himalayensis (Chen, 1936)

Haltica himalayensis Chen, 1936: 80; TL: NA; TD: NA

Taxonomic history: *Haltica himensis* Shukla, 1960, Agra Univ. J. Res., 9: 79 Kimoto and Takizawa, 1973, Kontyu, Tokyo, 41: 179 (=*himalayensis*); *Altica himalayensis* Chujo, 1966, J. Coll. Art and Sci. Chiba Univ., Nat. Sci., ser. 4: 556; *Altica himensis* Scherer, 1969, Pac. Ins. Mon., 22: 130 (see Reid and Beaton, 2015).

Material examined: India, Kashmir, Srinagar, CITH, 1640m, 15♀♀, 22♂♂, 07.iv.2015, 22.v.2015, 32♀♀, 17♂♂, 16.v.2016, 11.vi.2016 (coll. Mudasir Ahmad & Shahid Ali Akbar).

Distribution in India: Meghalaya (Khasi Hills), Kumaun Hills, (Uttarakhand), Assam, Himalaya, N.W. Himalaya, Kashmir, Simla (Himachal Pradesh), Sikkim, Uttar Pradesh and West Bengal (Kimoto, 1967; Scherer, 1969; Editor-Director, 1999; Döberl, 2003).

General distribution: Nepal, Bhutan, Taiwan, China (Tibet), Pakistan (Döberl, 2003; Löbl and Smetana, 2010; Nadein *et al.,* 2012; Azad *et al.,* 2015).

***Altica viridicyanea* (Baly, 1874)**

Graptodera viridicyanea Baly, 1874: 199; TL: Nagasaki, Japan; TD: BMNH

Taxonomic history: *Haltica viridicyanea* Maulik, 1926, Fauna India, Chrysom. & Halt., 422; *Altica viridicyanea* Ohno, 1960, Toyo Univ., Bull. Dept. Lib. Arts 1: 78, 86 (see Reid and Beaton, 2015).

Distribution in India: No specific state wise details provided (Chujo & Kimoto, 1961).

General distribution: Japan (Honshu, Sado I., Shikoku, Kyushu, Tsushima, Tanegashima); Ryukyu Is. (Okinawa); Korea; Manchuria; China (Gruev and Döberl, 2005).

***Altica caerulescens* (Baly, 1874)**

Graptodera caerulescens Baly, 1874: 190; TL: Nagasaki, TsuSima; China: Chusan; TD: NA

Taxonomic history: *Haltica caerulescens* Maulik, 1926, Fauna India, Chrysom. & Haltic., 421; *Altica caerulescens* Ohno, 1960, Toyo Univ., Bull. Dept. Lib. Arts 1: 79, 91(see Reid and Beaton, 2015).

Distribution in India: No specific state wise details provided (Chujo and Kimoto, 1961).

General distribution: Japan (Honshu, Sado I., Ao-ga-shima, Hachijo-jima, Shikoku, Kyushu, Tsushima); Ryukyu Is. (Amami-Oshima, Okinawa, Ishigaki, Miyako); Korea; Manchuria; China; Formosa; Taiwan (Gruev & Döberl, 2005).

***Altica* spec. A (Doeberl, 2003)**

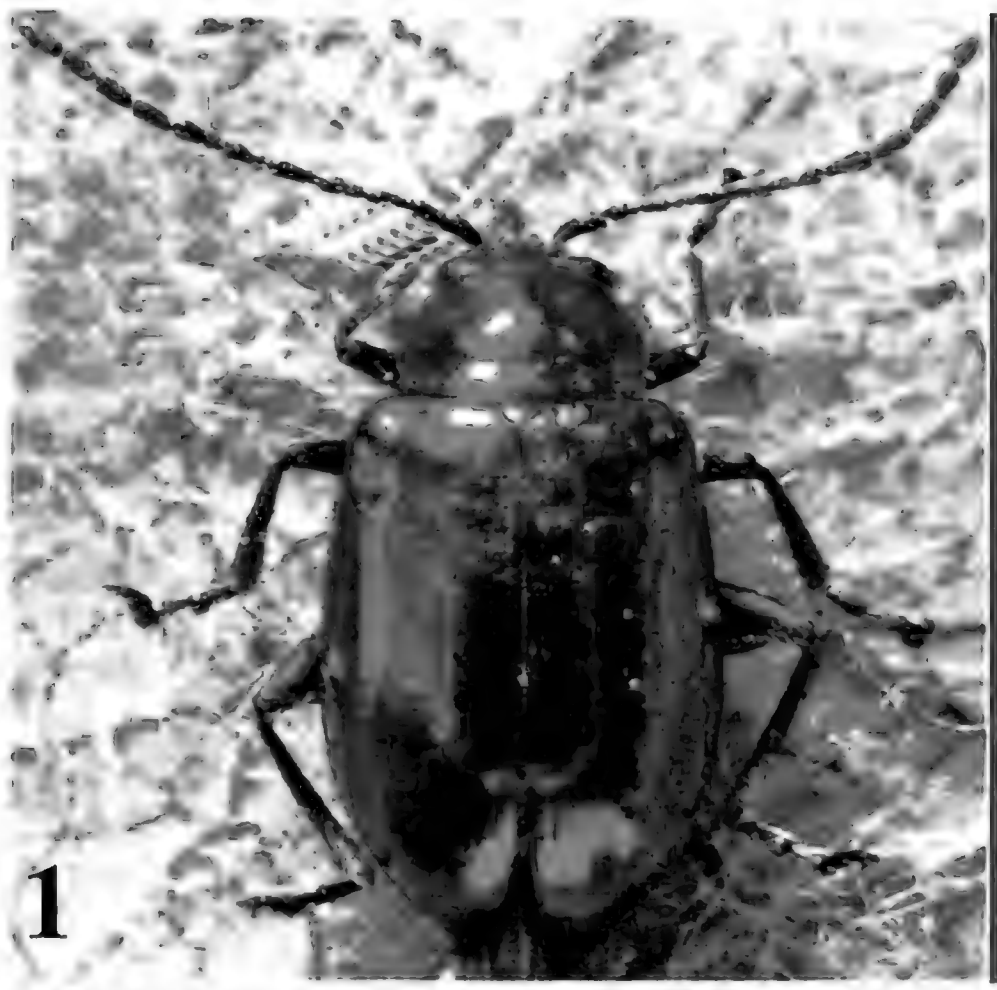
Altica spec. A Doeberl, 2003: NA; TL: NA; TD: NA

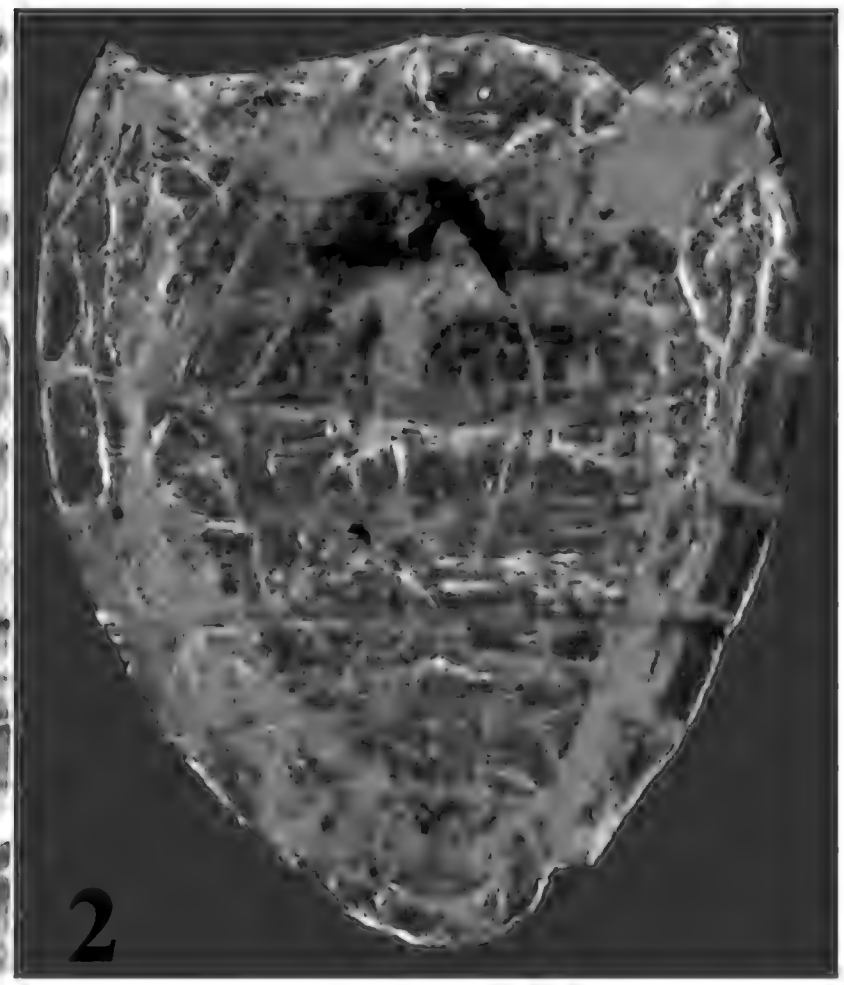
Remarks: Kashmir, Lake Anchar, IX- 16-1985, leg. C.W. and L.B. O'Brien and probably represents an undescribed species (Doeberl, 2003). The species has been reported from Kashmir (India) only.

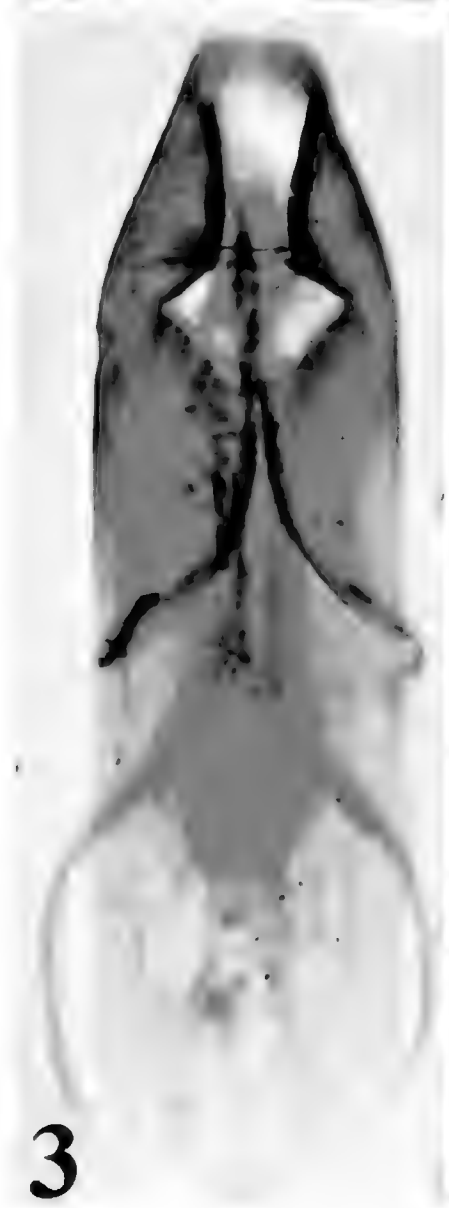
Study of type materials by Reid and Beaton (2015) signifies that all the common *Altica* species in the Indo-malaya have been misidentified. As such the *A. cyanea* of many authors should correctly be named *A. aenea* (Olivier, 1808), which is widely distributed (Kizub, 2016); *A. cyanea* Weber 1801, should correctly be applied to *A. caerulea*; The *A. caerulea* (Olivier, 1791) should be applied to the species generally known as *A. brevicosta* (Weise, 1922); *A. birmanensis* is a valid species but has been misidentified or conflated with *A. cyanea*.

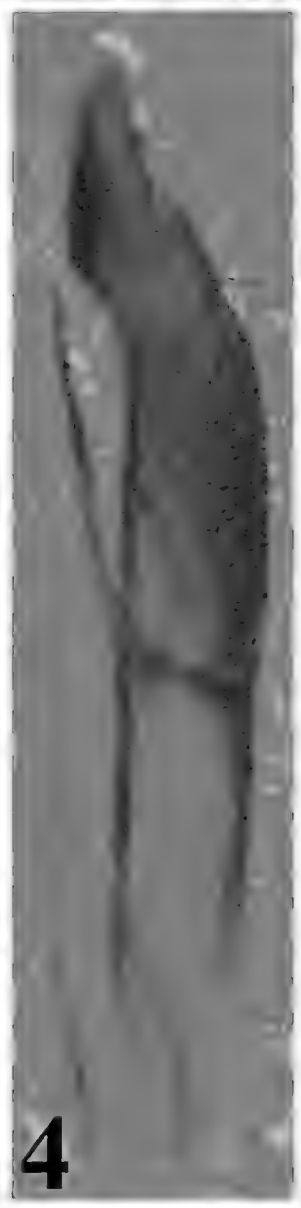
Chen (1936) described the species under the name *Haltica himalayensis*. Chujo and Kimoto (1961) established valid name of genus as *Altica* from *Haltica* that was subsequently accepted by Scherer (1969); Kimoto (1967); Reid and Beatson (2015). Shukla (1960) described *Haltica himensis* as new species from N.W. Himalaya. The species was later treated as *Altica himensis* by Scherer (1969) and eventually synonymized with *Altica himalayansis* by Kimoto & Takizawa (1973). The species is well established in Indian Himalayan regions (Kumaun Hills, Khasi Hills, Himachal Pradesh, Sikkim, Kashmir, Uttar Pradesh, West Bengal, Nepal, Bhutan, Taiwan, Asia, China (Tibet) (Singh *et al.,* 1986; Shah and Jyala, 1998). There is at least one established subspecies *A. himalayansis japonica* Ohno, 1960 confined to Japan and feeding on *Jussiaea prostrata* (Roxb.).

Description and diagnosis (Figs 1-5): Body more or less flat, medium sized, metallic blue to green with reddish or bronze sheen; head shapeoval, from lateral side convex; frontal ridge forms angular T–shaped ridge with head capsule along the anterior margin; antennae long, 11–segmented, filiform, raised, contiguous, oval and well delimited from frontal ridge laterally and from each other by furrows;

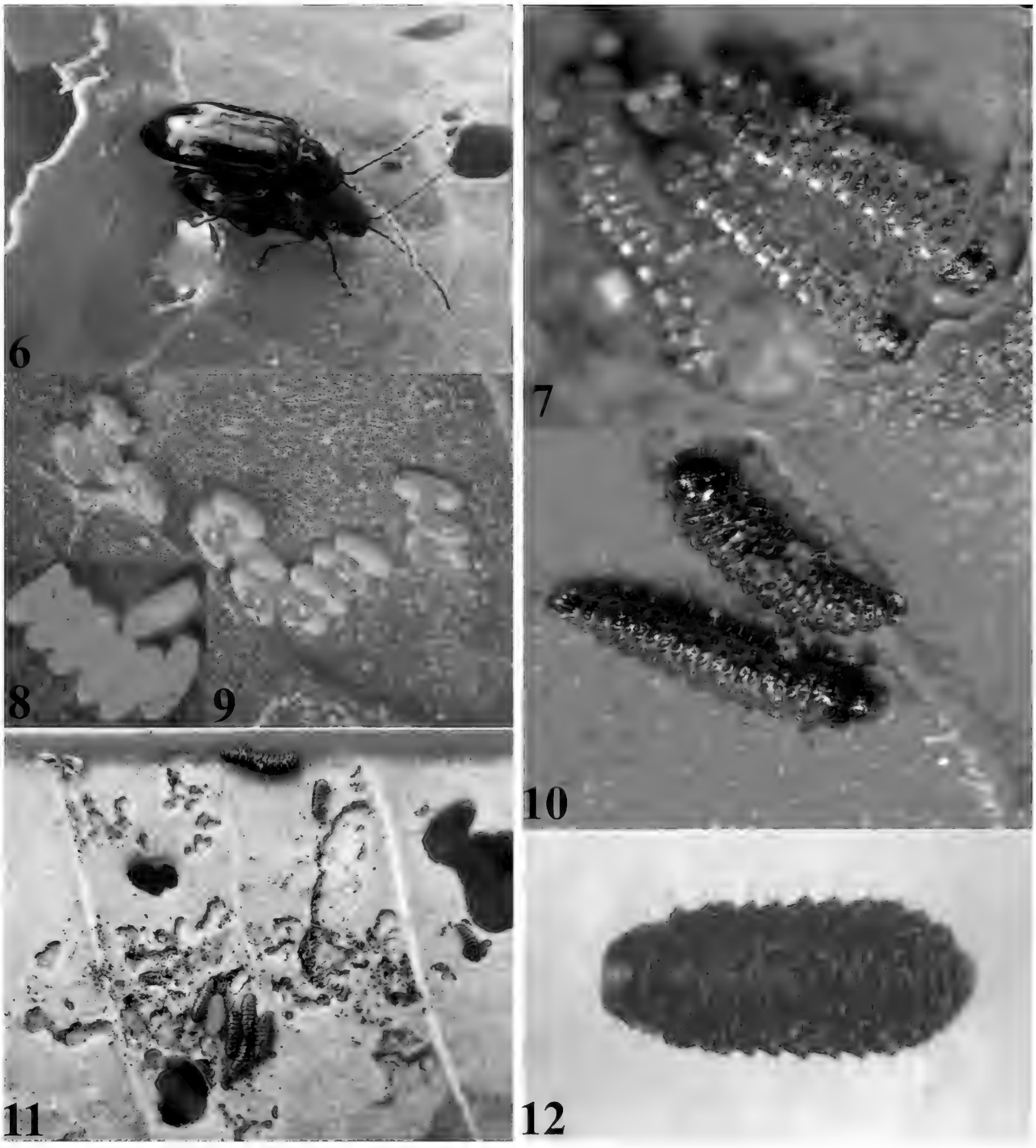








Figures 1-5: *Altica himalayensis*: **1.** Adult; **2.** Abdomen ventrites; **3-4.** Ventral and lateral side of male aedeagus; **5.** Female genitalia with receptacle of spermatheca and cylindrical spermathecal pump.



Figures 6-12: Biological stages of *Altica himalayensis*: **6.** Mating pair; **7.** First and second instars; **8-9.** freshly laid yellowish eggs, eggs about to hatch; **10.** Larvae with distinct black spots; **11.** Fourth instar; **12.** Fifth instar.

orbital line present; inter–antennal space slightly wider than diameter of antennal socket, but narrower than transverse diameter of eye; eyes small; clypeus long, labrum typical; pronotum more or less narrow with ante basal transverse impression, legs covered with hair especially tibiae, tarsi and peritarsus; tarsi two segmented and bilobed peritarsus ending with long claw bearing two curved spines. Abdomen ventrites with diffuse microsculpture and with recumbent pubescence; aedeagus in dorsal view parallel-sided with a narrowly truncate tip; dorsal

surfaces slightly curved in lateral view, ventral surface almost straight; venter without a distinct transverse or oblique ridges; female: tignum long, basal part narrow with pointed tip, lateral arms narrowly triangular to threadlike, and apex broadly triangular; spermathecal collum of variable length; vaginal palpi short, conical with obliquely truncate apex.

Seasonality and biology (Figs 6-12)

The life cycle of *A. himalayensis* from Kashmir Himalayas is atypical for alticines. Two generations occur in a year. During the latter half of November as the temperature goes down the pest undergoes diapause (usually for 2–3 winter months). The first generation of the pest after diapausing, become active and frequent in occurrence from second week of March and highest pest densities are attained during the month of July. During the start of the new season and onset of spring (starting weeks of March till latter half of April), the pest infestation becomes most conspicuous on *R. nepalensis*, a herbaceous perennial plant. The pest feeds, mates and oviposits on the tender leaves of *R. nepalensis* plants. The pest quickly multiplies and within a month (from March to April) all the life stages of the pest can be found on the host plant. These larvae are also seen to migrate and infest strawberry plants and cause damage. Usually 4 or 5 larval instars were observed. Pupation takes place in soil from first week of May and almost all the motile stages of the pest disappear by the end of second and third week of May. The second generation of the pest and the newly emerged adults from pupation are cited in the third week of June and onwards. With plenty of food available and conditions favorable, population increases. It is the second generation of the pest that infests major temperate horticulture crops and cause considerable damage. Larvae of the second generation are also seen actively feeding on the major fruit crops during July and the month of August. Pupation takes in the first week of September. Adult's emerges towards the end of September and beginning of October. The pest drops activity with very small population alive during the month of November and others diapause.

***Egg*:** The eggs are laid in loose clusters 6–14 in number, yellowish in colour, elliptical in shape (9–16µm length and 3.8–4.4µm width) laid on underside the leaves of the host plant. Incubation period ranges from 7–12 days after which a small larva emerges out from the egg.

***Larva*:** Larvae appear distinct with the presence of dark tubercles and prominent blunt-tipped setae. Newly hatched larvae are about 1.370–1.522 mm long and 0.431–0.650mm in width and mature larvae measures about 3.150–3.421 mm in length and 0.7–0.9mm in width. Pupation lasts for 12–15 days and usually takes place in soil. Larva is an external feeder and feed on leaves.

***Adult*:** The adults are small, shiny metallic blue in colour (4.201–5.321mm in length and 3.310–3.762mm in width). Males are slightly smaller in size than the female. The insect overwinters in the adult stage under the ground in cracks and crevasses.

On an average life cycle completes in 49-63 days. Adult longevity was recorded at 65–71 days and with each stage (eggs, larvae, and pupa) lasts for 9–12, 28–36, 12–15 days respectively.

Damage (Figs 13-18)

The pest is voracious and defoliates the fruit trees resulting in reduced yield and less vigor of tree. Adults are highly gregarious forming swarms while larvae are an external feeder and feed on leaves. The adult and larvae feed together and skeletonises leaves leaving only midribs and few veins. This characteristic damage and large pest populations were found in all the orchards sampled. No threshold limits of the pest has been set so far, however it was found that 7–8 beetles/leaf can cause complete skeletonisation within 24 hours and in case of heavy infestations about 20–40 beetles were present per leaf. High incidence and severity rates were observed in case of heavy pest infestations.

Acknowledgements

The authors are thankful to Director, CITH and ICAR for providing necessary facilities and encouragements. The corresponding author would also like to thank Department of Science and Technology (DST),

Figs. 13-18. Seasonality and nature of damage: **13, 15.** Overwintering adults; **14, 16-18.** Adult feeding on various fruit crops.

Govt. of India, New Delhi for research encouragement and financial assistance rendered via; N-PDF Fellowship program: File No: PDF/2015/000866.

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*Conserved name ICZN. 1994. However, David G. Furth argued that *Altica* had been cited by Geoffroy, 1762, and O. F. Müller, 1764, invalidly, and the first valid citation is Fabricius, 1775.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 19-25, 2019
doi: 10.5281/zenodo.3462982

Wing geometric morphometrics as a tool for taxonomic identification of two fly species (Diptera: Muscidae) of forensic relevance

José Antonio Nuñez[1], Pablo Jarrín-V.[2] and *Jonathan Liria[2,3]

[1]*Department of Morphological and Forensic Sciences. School of Biomedical and Technological Sciences. Faculty of Health Sciences, Universidad de Carabobo, Valencia, Venezuela.*
[2]*Research Group on Population and Environment, Universidad Regional Amazónica Ikiam, Napo, Ecuador.*
[3]*Center of Studies in Applied Zoology, Universidad de Carabobo, Valencia, Venezuela.*

(Email: jonathan.liria@gmail.com)

Abstract

The taxonomic identification of fly species through wing geometry is a helpful tool for entomologists and officials involved in forensic research, who not necessarily require expertise on insect taxonomy. Members of the Muscidae family are relevant sources of evidence in forensic entomology; however, developing countries often lack experts in the taxonomical identification of essential species for the assessment of aspects such as the minimum postmortem interval (mPMI). Our study proposes a low-cost, fast, and technologically-accessible quantitative tool for the identification of *Atherigona orientalis* and *Ophyra aenescens*, associated with human corpses at advanced states of decomposition. We propose a tool that is based on the geometric variability observed in eight homologous landmarks on wing veins and the interpretation of morphometric estimates after a generalized Procrustes analysis. The use of a geometric approach for effective discrimination between *Atherigona orientalis* and *Ophyra aenescens* was supported by statistically significant differences in wing conformation and size. The evidence presented in this study shows that the analysis of geometric variability in the wing morphology of species of forensic relevance can contribute to simple and objective species identification. Geometric morphometrics is a simple and readily available tool for forensic science.

Keywords: *Muscomorpha, Calyptratae, forensic entomology, landmarks.*

Received: 21 January 2019; Revised: 13 September 2019; Online: 30 September 2019.

Introduction

Bacterial activity drives physico-chemical changes during the decomposition of cellular tissues in a lifeless human body, that attract scavenging species on specific brackets of time and at delimited anatomical parts of the host. The tempo and mode of corpse colonization by scavenging species has an inherent ecological complexity, which is associated to the death, decomposition, and putrefaction of the human body, and which is the subject of forensic entomology. Several factors further affect the decomposition process. For example, the larger the volume and mass of the decomposing body are, the greater the abundance and complexity the cadaveric entomofauna has (Matuszewski *et al.*, 2016). Wells and LaMotte (2017) defined the term "forensic entomology" as all activities associated with the use of insects to estimate the moment of death. The former authors also defined two common sources of information for postmortem interval estimation. The first was based on the development of an individual insect, particularly blow flies (Calliphoridae). The second was related to changes in the composition of insect communities in a corpse (succession).

The minimum postmortem interval (mPMI) is frequently used in forensic entomology and allows the establishment of time intervals between corpse discovery and time of death; both are sources of evidence that can be used to verify the testimonies of witnesses and defendants. It is essential for forensic procedures to understand the ecological succession, life cycles and taxonomy of the species associated to corpses,

mainly because the use of the entomofauna as evidence depends on various circumstances which are often specific to each investigative case (Keshavarzi *et al*., 2016). The presence of external and environmental factors, such as clothing and temperature, affects the mPMI due to the extended time that insects take to colonize the host (Matuszewski *et al*., 2016).

As active decomposers of corpses, members of the Muscidae family are essential to forensic science and are present in tropical and subtropical regions of the world (Grzywacs and Pape, 2014). The large number of flies and the diversity of Muscidae species that are found in corpses at tropical regions requires significant taxonomical effort and entomological expertise, which is not always available to forensic cases in developing countries. Latin America has traditionally lacked the interest to develop new knowledge and technologies in forensic science that could be adapted to local conditions and which could use the available entomofauna as an indicator of time of death (Ramos-Pastrana *et al*., 2012; García-Ruilova and Donoso, 2015; Rodríguez-Olivares *et al*., 2015). Based on empirical evidence, Ramírez (2012) has remarked on the scarcity of experts in the study of Muscidae as indicators of the mPMI, which has a negative influence on the development of forensics in the South American region.

As is the case of *Atherigona orientalis* Schiner, 1868 and *Ophyra aenescens* (Wiedemann, 1830), certain Muscidae species can represent considerable challenges for taxonomy, despite their usefulness for forensics, as both species can be used as source material for fast and low-cost alternatives for mPMI estimation, but due to their small size, these species are often discarded during forensic processes and analyses (Grzywacz *et al*., 2017a; Ren *et al*., 2018).

Other studies in forensic entomology have demonstrated the importance and benefit of using the morphology of scavenging species for taxonomical identification and the subsequent use of determined species as markers of the mPMI (Lyra *et al*., 2010; Vásquez and Liria, 2012; Nuñez and Liria, 2016a,b; Macedo, 2017). The wing structure in adults and the cephalopharyngeal skeleton in larvae have been shown to have useful information for taxonomical classification (Lyra *et al*., 2010; Vásquez and Liria, 2012; Nuñez and Liria, 2016b). By employing homologous features in biological organisms, geometric morphometrics serves to quantify phenotypic variation and explore changes in morphological shape (Bookstein, 1991). Our study presents quantitative tools in geometric morphometrics for the identification of *Atherigona orientalis* and *Ophyra aenescens*, both species were proposed as relevant to the determination of the mPMI in human corpses at advanced states of decomposition.

Materials and Methods

Specimens and data

Bovine meat was left to rot for five days. This advanced state of decomposition served as bait to collect a total of 64 specimens in *Atherigona orientalis* (n=32) and *Ophyra aenescens* (n=32). Individuals were classified into either of both species by taxonomic keys (Carvalho *et al*., 2002; Patitucci *et al*., 2013). We sampled for flies at an urban zone in the city of Valencia (Carabobo State, Venezuela, 10°13'78'' N and 68°00'32'' W). The right wings of each specimen were dissected and fixed on microscope slides with Faure's aqueous fixing medium and prepared according to the protocol by Martín (1994), which includes distilled water (50 ml), Arabic gum (30 gr), glycerol (20 ml), and chloral hydrate (50 gr). We photographed the 64 wings with a digital camera (Sony Cyber Shot 16.2) mounted on a microscope (Nikon Eclipse E100) and assisted by a tripod. We digitized each wing image on x and y coordinates with the TPSDig digitizing program (Rohlf, 2008). We established a total of eight homologous landmarks on wing veins, which correspond to type I landmarks according to Bookstein (1991) and named after the anatomical definitions by McAlpine (1987). These homologous landmarks (LM) were: intersection of the subcoastal cell with the wing margin (LM1), intersection between the R1 vein with the wing margin (LM2), intersection between the R_{2+3} vein and the wing margin (LM3), intersection between vein R_{4+5} and the wing margin (LM4), intersection of the cubital-median transversal discal vein with the median vein (LM5), intersection of the median vein with the transversal radio-median vein (LM6), intersection of the radial vein (R_{4+5}) with the transversal radio-median vein (LM7) and intersection at the bifurcation of the radian vein at R_{2+3} and R_{4+5} (LM8).

Morphometric analysis

We used a generalized Procrustes analysis on MorphoJ (Klingenberg, 2011) to estimate shape variables and centroid size (CS) from the landmark coordinates obtained from the 64 specimens. We subsequently used the shape variables for a discriminant analysis (DA) that provided insights on the quantitative classification of specimens into either *Atherigona orientalis* or *Ophyra aenescens*. Differences between classified individuals on CS were analyzed by a Kruskal-Wallis test, with a Bonferroni correction on PAST (Hammer and Harper, 2011).

Results

There were significant differences (x^2=47.26, df=1, P < 0.001) on wing geometric size *Atherigona orientalis* ($\bar{x}$=1294.83 pixels (px), sd=101.97 px) and *Ophyra aenescens* ($\bar{x}$=1794.30 px, sd=98.33 px). As shown by the first function inferred from the DA, the shape of the wing, as quantified by the selected landmarks, is a significant discriminator of both *Ophyra aenescens* and *Atherigona orientalis* (Fig. 2). The totality of studied individuals is correctly classified into their corresponding species on the first discriminant function. The first discriminant function on wing shape is statistically significant as inferred by a Hoteling's T-square test (T^2=2553.16, P<0.0001). An interpolation of the average thin-plate splines estimated for both *O. aenescens* and *A. orientalis* shows the main features that differentiate these two species in terms of the general geometry of the wing at the established landmarks (LM1-LM8). The overall geometry for *O. aenescens* is much constricted or compressed than that for *A. orientalis*. In this same sense, the latter species has a broader and more squared wing than the former.

Discussion

Atherigona orientalis is a pantropical species, frequently found on forensic cases, and therefore the individuals of this species are relevant to criminalistic studies. Proper identification of this species is essential to the study of ecological succession on human corpses in urban areas of Venezuela and other countries such as Ecuador (Salazar and Donoso, 2015) and Colombia (Uribe *et al.*, 2010). *Atherigona orientalis* shows a preference for diverse substrates such as feces, entrails, urban residues, corpses, fruits, and plant organic material (D'Almeida and Pinto, 1996; D'Almeida and Almeida, 1998; Salazar *et al.*, 2012). The presence of this species on laboratory rat corpses (*Rattus norvegicus* Berkenhout, 1769), rabbits [*Oryctolagus cuniculus* (Linnaeus, 1758)] and monkeys (*Macaca fascicularis* Raffles, 1821) has been reported as early as the first day of death (Azwandi *et al.*, 2013). This species has also been found in corpses at advanced states of decomposition, or that have been partially carbonized (Oliveira *et al.*, 2014; Mashaly, 2016). Its presence has also been reported in Venezuela on pig corpses after the third day of death (Centeno, 2016). *A. orientalis* can be confused with *A. reversura*, the Bermudagrass stem pest, which was recorded for the first time in Argentina (Patitucci *et al.*, 2016) and later in Brazil (Ribeiro *et al.*, 2016). However, both species can be differentiated by the following characteristics: 1) In *A. orientalis* the wing r-m crossvein is beyond the middle dm cell, as well as beyond the intersection of the subcostal and costal veins. 2) In *A. reversura* the r-m crossvein is always present in the basal half of the dm cell and anterior to the intersection of the subcostal and costal veins (Ribeiro *et al.*, 2016).

Ophyra aenescens is a widespread species, which is originally from the Neotropics. This species has been reported on human corpses during exhumation, therefore it is valuable for the study of taphonomic processes (Mariani *et al.*, 2014) and mPMI estimation on corpses at advanced states of decomposition, regardless of season or time of year (Rocha *et al.*, 2009; Battán *et al.*, 2010). The presence of this species has been reported from Venezuela in morgues and urban zones of the Carabobo state (Nuñez *et al.*, 2016). This species can be recognized from other members of the genus by the presence of yellow-orange palpi and a long and wide ocellar triangle, with a rounded apex that reaches the lunule (Carvalho *et al.*, 2002; Patitucci *et al.*, 2013).

As shown in the present study, the use of geometric landmarks on insect wings and the geometric assessment of biological shape allow for objective and accurate taxonomical identifications on quantitative grounds and

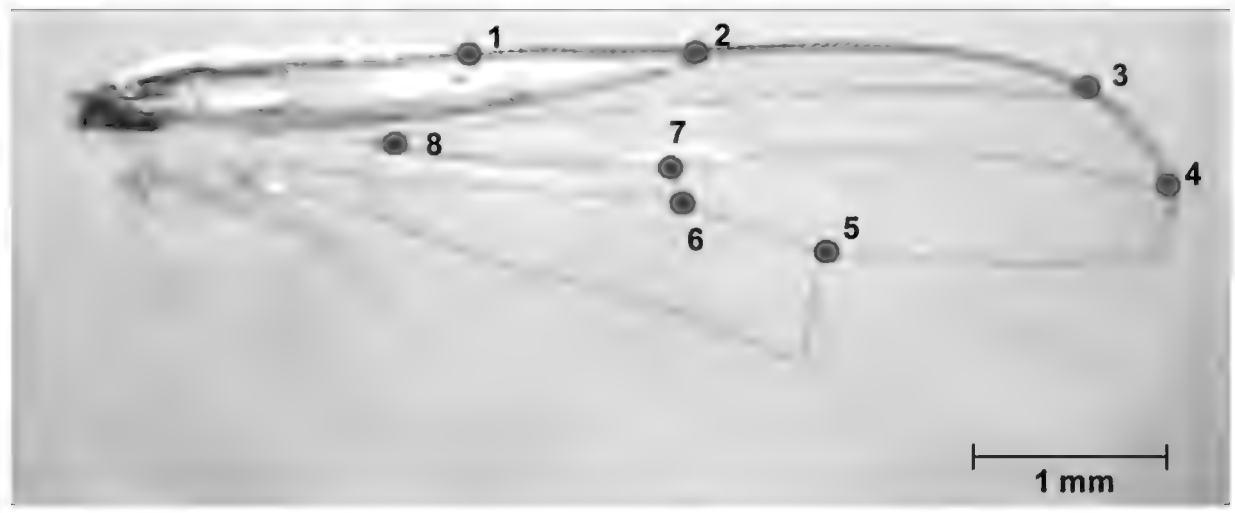

Figure 1. Wing of *Ophyra aenescens*, showing the arrangement of landmarks (LM1-LM8).

Figure 2. Histogram of the first canonical axis after a discriminant analysis on the wing morphology of *Atherigona orientalis* and *Ophyra aenescens*.

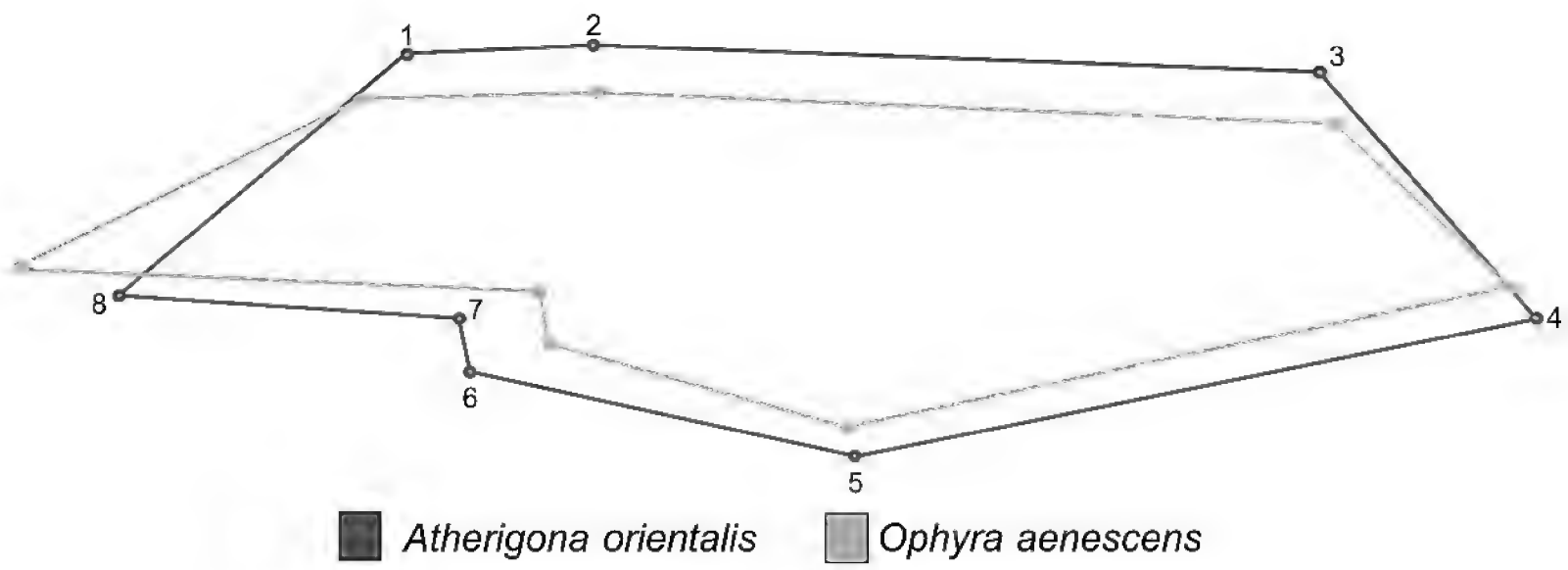

Figure 3. Thin-plate spline showing the average differences in wing shape between *Atherigona orientalis* and *Ophyra aenescens*.

with an estimate of statistical error. For 13 genera of forensic relevance in the Muscidae family, the use of geometric morphometrics on wing landmarks can have a 99.8% taxonomic accuracy (Grzywacs *et al*., 2017b). Our study differs from Grzywacs *et al*. (2017b) in that we used a set of eight landmarks, instead of fifteen, and we also included size as a relevant factor; also, Grzywacs *et al*. (2017b) did not provide details on those landmarks which were more critical to establish differences between genera or species. Grzywacs *et al*. (2017b) used a relatively low sample size to represent four genera (*Azelia*, *Graphomya*, *Mydaea,* and *Polietes*), and this may preclude a robust estimation of the necessary covariance matrix for CVA/MANOVA, especially considering that sample size must often be larger than the number of analyzed variables. The differences in methods between Grzywacs *et al*. (2017b) and our research make comparison of both studies difficult.

As a tool, the taxonomical identification via wing geometry is an advantage to both entomologists and forensic officials who are involved in forensic research, and who do not necessarily require proved expertise on insect taxonomy. However, the use of quantitative tools for the taxonomical identification of entomofauna of forensic relevance should always follow an initial qualitative approach on taxonomy, often supported by taxonomical keys. Quantitative assessments of morphology are particularly necessary for genera such as *Hydrotaea, Ophyra,* and *Muscina*.

Quantitative tools, such as the geometric analysis of insect wings, could serve to evaluate the presence and magnitude of sexual dimorphism. An assessment of wing geometry through quantitative methods can also be used for determining the relation of morphological variation and community structure to environments and substrates such as corpses. The application of geometric morphometrics has been applied with success in the Calliphoridae and Piophilidae families, both groups have forensic relevance (Nuñez and Liria, 2016b; 2017; Sontigun *et al*., 2017).

The evidence presented in this study showed that the analysis of the geometric variability of the wing structure of forensically relevant species is a simple and affordable tool. This proposed tool can also contribute to the development of techniques and procedures that will allow an objective and efficient estimate of the mPMI. Researchers in forensics should work together to construct a morphological database, which should include the largest possible collection of individuals and species of forensic relevance, including their morphological characteristics (e.g. wing photographs and landmarks), and associated geographic and ecological information (e.g. substrate availability and preferred temperatures). This morphological database will allow forensic science in Venezuela and the Latin American region to develop methods and capabilities adapted to local conditions for efficient forensic processes. It is in this context that forensic science in Latin America must be strengthened on three fundamental aspects for effective use of entomofauna and the estimation of the mPMI, which are: 1) traditional taxonomy, 2) molecular techniques and 3) geometric morphometrics.

Acknowledgments

This research would not have been possible without the support of the Department of Biology and Department of Morphological and Forensic Sciences, University of Carabobo.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 26-30, 2019
doi: 10.5281/zenodo.3464962

Some interesting observations on the parasitisation of *Danaus chrysippus* (Lepidoptera: Nymphalidae) by *Sturmia convergens* (Diptera: Tachinidae) from West Bengal, India

Moumita Bhowmik[1], *Rajmohana K.[2] and Sunita P.[2]

[1] *Department of Zoology, Serampore College, 8, William Carey Sarani, Maniktala, Serampore, West Bengal- 712201, India.*
[2] *Zoological Survey of India, New Alipore P.O., Kolkata, West Bengal-700053, India.*

(Email: mohana.skumar@gmail.com)

Abstract

The tachinid fly, *Sturmia convergens* (Wiedemann, 1824) is one of the most important parasitoids, causing heavy mortality in *Danaus chrysippus* (Linnaeus, 1758). The present work documents for the first time, the gregarious behavior of *S. convergens* in the host larvae. The parasitoid can very well complete its development within the larval stage of the host. A single host larva is capable of provisioning the full development of up to 8 larvae of *S. convergens*. The study also reports them as true larval and larval-pupal parasitoids of *D. chrysippus* on *Calotropis gigantea* (Linnaeus) Dryand, 1811.

Keywords: *Gregarious, Sturmia convergens, Tachinidae, Danaus chrysippus, parasitoid.*

Received: 10 January 2019; Revised: 13 May 2019; Online: 30 September 2019.

Introduction

Insect parasitoids mainly belong to orders- Hymenoptera, Diptera, Coleoptera, Lepidoptera and Neuroptera and they have a significant role in regulating the population of their host groups. Though the majority of parasitoids are hymenopterans, 21 families, with about 16000 species in Diptera are known to be parasitoids (Eggleton and Belshaw, 1992; Feener and Brown, 1997), Tachinidae being one among them. Tachinid flies are a bit larger in size to houseflies and have more number of bristles. They mostly have Lepidoptera as their major hosts, though a few attack Coleopterans and Hymenopterans too (O' Hara, 2008). *Sturmia convergens* (Wiedemann, 1824) (Tachinidae: Exoristinae) (Fig. 1) is an endo-parasitoid of the Nymphalid Plain Tiger butterfly, *Danaus chrysippus* (Linnaeus, 1758) (Ahmed *et al.,* 2014; Gupta *et al.*, 2015). They lay tiny black eggs on the leaf surface of the milkweed plant and are ingested by *D. chrysippus* caterpillars, along with the plant matter. The eggs hatch within the body of the caterpillar, and develop into larva. By the time the host larva pupates, the fully grown tachinid maggot emerges out and readily pupates (Fig. 2) in soil or other suitable substratum and develops as an adult fly (Mathavan, 1975). The present work deals with some interesting aspects of parasitisation of *D. chrysippus* by *S. convergens* on *Calotropis gigantea* (Linnaeus) Dryand, 1811 in West Bengal. The work documents the gregarious behavior of the species for the first time and also reports *S. convergens* as both larval parasitoids and larval pupal parasitoids.

Materials and Methods

A total of 39 larvae of *D. chrysippus* were collected by hand picking from a profusely branched *C. gigantea* plant at Howrah district, West Bengal, (22°35'34.55" N, 88°17'57.35" E, 12 m elevation), during the period of November, 2017 to March, 2018. The larvae were reared individually in small petri dishes, providing fresh leaves and buds from the host plant. The experiment was carried out under the prevailing temperature and relative humidity as indicated in Table 1. The longevity of the host stages and

parasitoids were recorded as in Table 3. Morphometrics of larval, pupal and adult stages of *S. convergens* were measured using ocular micrometer (Table 4). Host emergence and parasitoid emergence were observed and carefully documented (Fig. 2). Photographs were taken using digital camera, Panasonic DMC-FH2. The identity of the parasitoids was confirmed with the help of taxonomic expertise available at Zoological Survey of India, Kolkata.

Table 1: Climatic parameters

Month	Average temperature	Average humidity
November	34ºC	70%
December	21ºC	74%
January	18ºC	68%
February	24ºC	61%
March	29ºC	61%

Observations and Results

The present study documents *S. convergens* as one of the most important natural enemy of *D. chrysippus*. Overall, from the 39 caterpillars observed, 35 maggots of the parasitoid emerged from the hosts (16 from caterpillars and 19 from pupae) and among them, 29 successfully developed into adult flies. *D. chrysippus* caterpillars were most abundant during mid December 2017 to mid January 2018, the peak winter time and were seen pupating not only on the host plants, but also on the boundary walls, piled bricks, and also stumps and poles in the backyard, within 10m radius of the host plant.

During the first half of November 2017, a single caterpillar of *D. chrysippus* was collected on *C. gigantea*, which successfully pupated and developed into an adult butterfly. No parasitisation could be documented.

Later during mid-November to mid December 2017, twenty caterpillars were collected, all of them successfully pupated and among the twenty pupae, only 3 developed into butterflies. From each of the remaining 17 pupae, a single maggot emerged making a hole in the pupal case (Fig. 2). Of them 16 successfully developed into adult *S. convergens* flies.

From mid December 2017 to mid January 2018, twelve caterpillars were collected, 8 successfully pupated and 4 of them emerged into adult butterflies. From the remaining pupae, 4 maggots emerged, one per pupae and all the four maggots developed into adult parasitoid flies. However, in the second half of February 2018, only 2 caterpillars were collected. From each caterpillar, 4 maggots emerged, rupturing the body wall. In total 8 maggots successfully pupated and developed into adult flies.

During March, out of the 4 caterpillars collected, 2 died and one developed into an adult butterfly. From the remaining one caterpillar, 8 maggots emerged (Fig. 3) and almost 30 minutes were taken for the total emergence. Only 7 of them developed into adults.

The entire mortality caused by the *S. convergens* on *D. chrysippus* has been represented in Fig. 4. The larval mortality and pupal mortality of *D. chrysippus* by *S. convergens* have been 9.09% and 57.57% respectively.

Discussion

Parasitoids are generally classified on the basis of the stage of the hosts they attack. When the parasitoid deposits its eggs inside the larva of the host and if the progeny after completing development, emerge from the host larvae itself, the parasitoid is termed a true larval parasitoid. If the same progeny completes its development late and emerge only from the host pupa, then it is a larval-pupal parasitoid. The present study reports *S. convergens* as true larval parasitoids as well as larval-pupal parasitoids. The exit time of the parasitoid from the host is ruled by the nutritional condition of the host for tachinids, though ecological factors could also be relevant (Cho *et al.,* 2010). Since only a single maggot of *S.convergens* often emerged from the host pupa, they were documented widely as solitary parasitoids (Mathavan, 1975; Gupta *et al.*, 2015). The larvae usually exit the host body at the pupal stage of *D. chrysippus* since the parasitoid has to wait for that much time to get enough nutrition to complete its development

(Mathavan, 1975). But *S. convergens* at two instances in this study were gregarious in the host larvae, since multiple individuals (upto eight) emerged from a single host caterpillar (Table 2). This parasitoid can very well complete its development within the larval stage of the host and apparently, a single host larva is capable of provisioning the full development of up to 8 larvae of *S. convergens* (Fig. 3). However, such instances are very rare, because compared to the early instars, usually the chances of the tachinid eggs getting ingested by the host caterpillar is more by the late larval instars, when they feed voraciously (Mathavan, 1975) and the development of the larvae in such cases is completed only in the host pupae. Further the early instars are often inadequate in providing enough nourishment to the developing parasitoid, even if the parasitoid eggs start developing in them.

Table 2: Sampling data from November 2017 to March 2018

Sampling period	No. of caterpillars collected	No. of butterfly pupae formed	No. of adult butterflies emerged	No. of maggots emerged from caterpillar	No. of maggots emerged from butterfly pupa	No. of adult parasitoid flies emerged
November, 2017 (First half)	1	1	1	0	0	0
Mid November 2017 to mid-December, 2018	20	20	3 (males)	0	17	16
Mid December, 2017 to mid-January, 2018	12	8	4 (3 males, 1 female)	0	2	2
Mid January and February, 2018	2	0	0	8 (4 maggots from each of the 2 caterpillars)	0	4
March, 2018	4	1	1	8 maggots from a single caterpillar	0	7

Table 3: Average duration of different stages and longevity (in starved condition) of *S. convergens*

Life stages	Average time duration (days)
Egg	Not assessed
Larva	0.58
Pupa	16.5
Adult	4.71

Table 4: Average body size of different stages of *S. convergens*

Life stages	Length in mm (Average ± SD)	Breadth in mm (Average ± SD)
Egg	Not assessed	Not assessed
Larva	9.87 ± 1.44	5.17 ± 0.95
Pupa	7.66 ± 1.32	4.81 ± 1.06
Adult	9.55 ± 1.23	3.84 ± 0.41

Figs. 1-3: *Sturmia convergens* **1**. Adult; **2.** Pupa of *S. convergens* along with host pupa with emergence hole; 3. Emerged maggots and the host caterpillar.

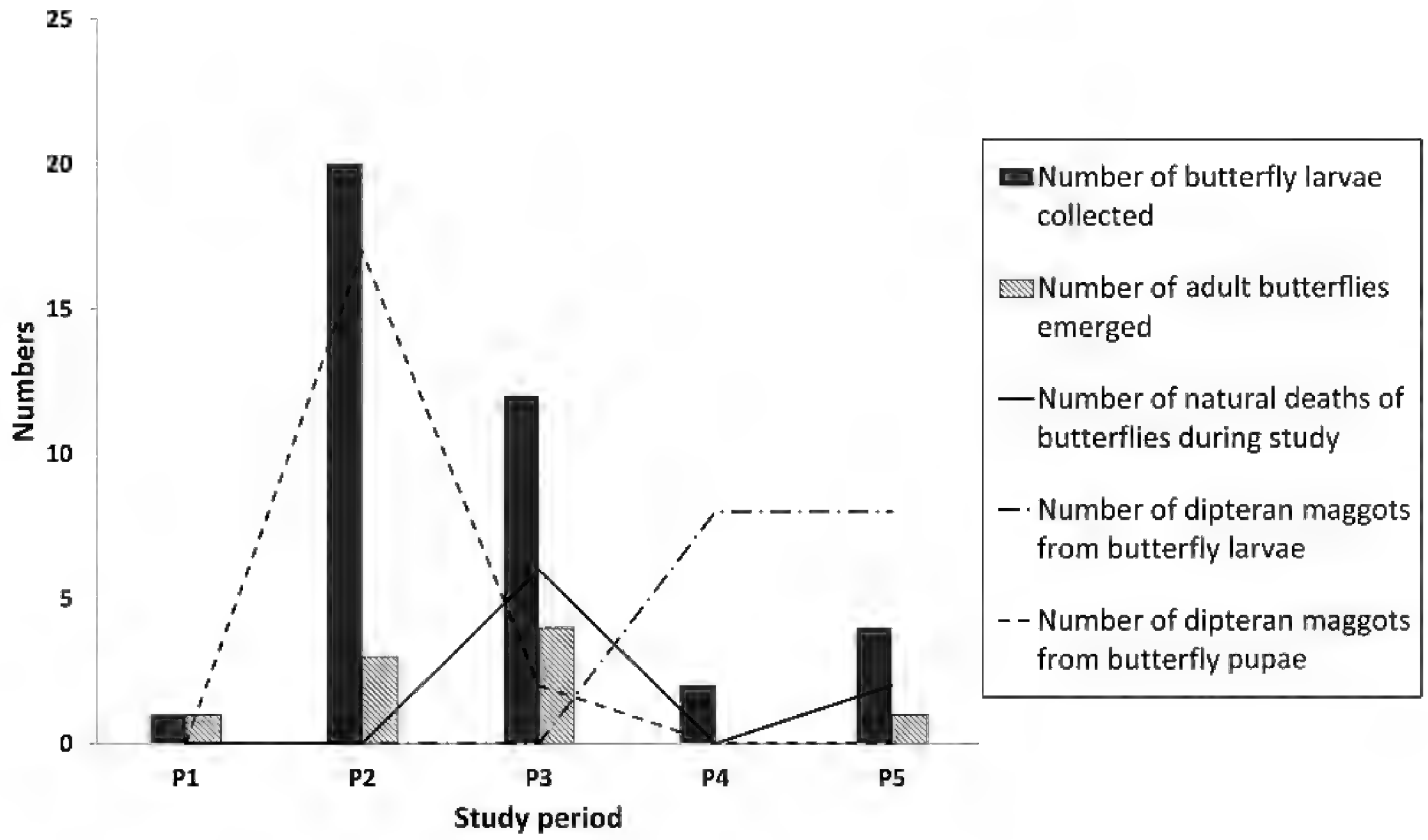

Fig. 4. Host-parasitoid interaction between *D. chrysippus* and *S. convergens*

Conclusion

With several flies emerging out of the host caterpillar, the tachinid endoparasitoid, *S. convergens* can be gregarious at larval stage of the host, and cause very high mortality to *D.chrysippus*.

Acknowledgements

The second and third authors thank the Director, Zoological Survey of India (ZSI), for encouragement and facilities granted towards this study. The authors express their gratefulness to Mr. Panchanan Parui, the retired Dipteran taxonomist of ZSI, Kolkata, for confirming the taxonomic identity of the tachinid parasitoid as *Sturmia convergens*. They are also thankful to Mr. Tridip Datta, for developing a graphical representation of the host mortality by the parasitoid.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)

HALTERES, Volume 10, 31-34, 2019
doi: 10.5281/zenodo.3552178

New record of the Palearctic species *Stigmus convergens* Tsuneki (Hymenoptera: Crabronidae: Pemphredoninae) from India

***Tessy Rajan[1], P.M. Sureshan[1], P. Girish Kumar[1] and Altaf Hussain Sheikh[2]**

[1]Western Ghats Regional Centre, Zoological Survey of India, Eranhipalam, Kozhikode, Kerala-673006, India.
[2]Government Degree College, Pulwama, Jammu & Kashmir- 192305, India.

(Email: tessy.rajan3@gmail.com)

Abstract

The crabronid wasp species *Stigmus convergens* Tsuneki, 1954 is newly recorded from India. A key to the Indian species is also provided.

Keywords: *Pemphredoninae, Stigmus convergens, new record, key, India.*

Received: 2 January 2019; Revised: 1 October 2019; Online: 25 November 2019.

Introduction

The crabronid wasp genus *Stigmus* Panzer, 1804, consists of small wasps with petiolated abdomen. All the members of this genus are hunters of aphids. They burrow in dead twigs or rotten branches of certain shrubs and arrange several brood-chambers in lineal order. Sometimes the wasps utilize pre-existing cavities but may excavate their own nests (Tsuneki, 1954; Bohart & Menke, 1976). This genus consists of 25 species worldwide of which only one species is reported from India viz. *Stigmus cuculus* Dudgeon (Pulawski, 2018). In this paper, we are reporting *Stigmus convergens* Tsuneki, 1954, for the first time from India. This species is so far recorded from Japan, Russia and Korea (Tsuneki, 1954; Budrys, 1987; Kim, 2014). Further, Tsuneki (1971) described an additional subspecies viz., *Stigmus convergens ami* from Taiwan and Porter *et al.* (1999) reported it from China.

Materials and Methods

This study is based on a single female specimen collected from the Heff village of Shopian district of Kashmir; three female specimens from Nowpora village of Anantnag district of Kashmir and a female specimen from Kanatal village of Tehri Garhwal district of Uttarakhand. The specimens are studied and photographed by using a Leica Stereo microscope model LEICA M 205A with LEICA DFC 500 Camera. The identified specimens are deposited at Western Ghat Regional Centre, Zoological Survey of India, Kozhikode (ZSIK).

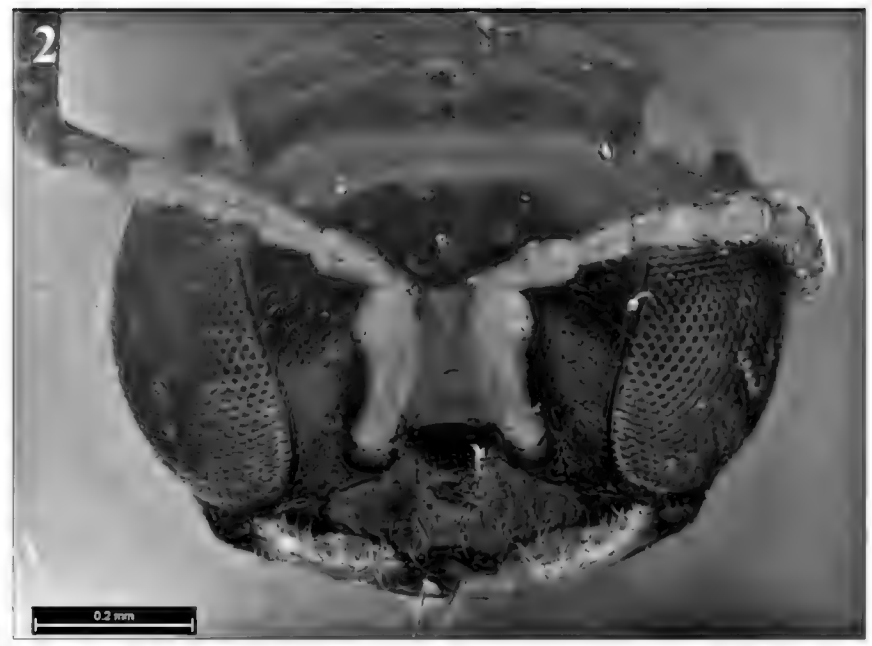
Results

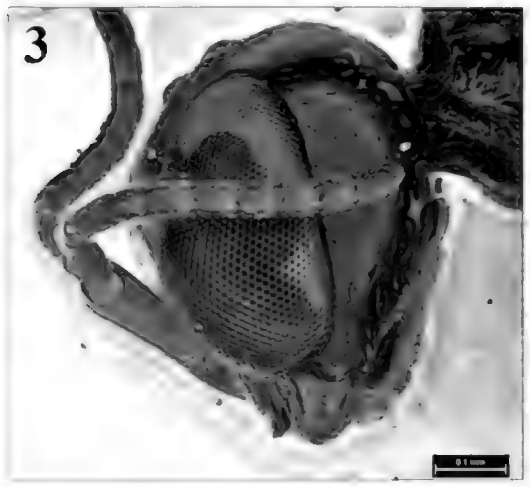
Stigmus convergens Tsuneki, 1954

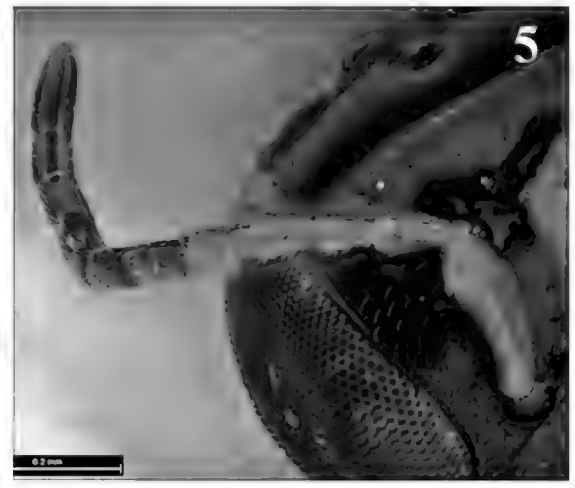
(Figs 1-9)

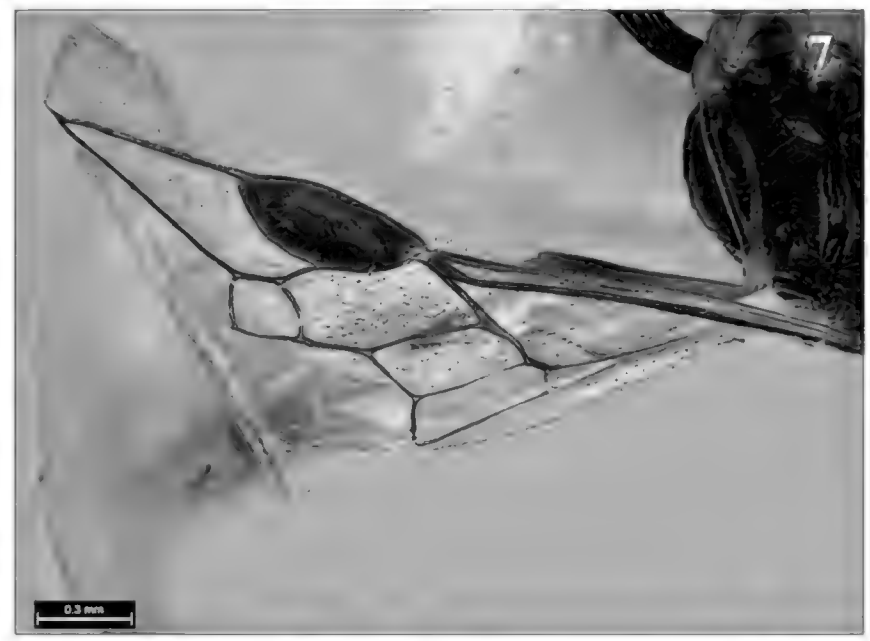
Stigmus convergens Tsuneki, 1954: 33, ♀.
Holotype: ♀, Japan: Hokkaido: Akagawa near Kucchian (originally K. Tsuneki coll., now Hyogo Mus.).

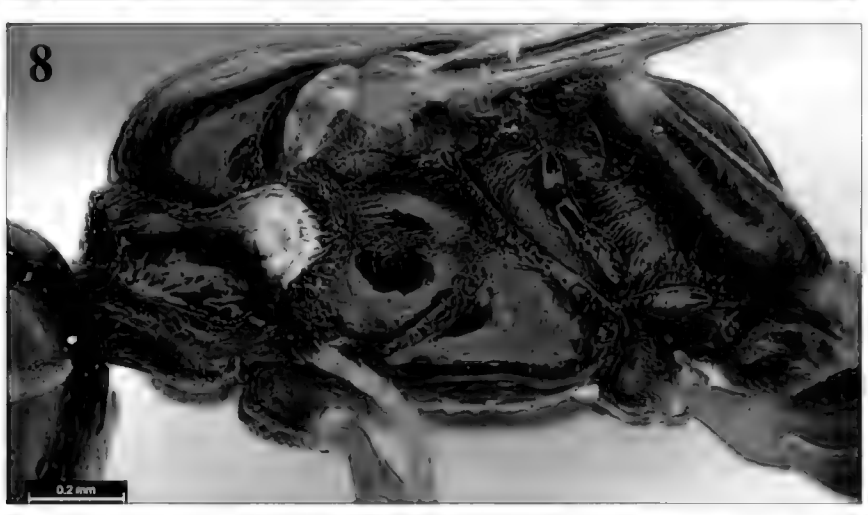
Diagnosis: *Female:* Apex of clypeus deeply emarginate (Fig. 4); paraorbital sulcus absent (Fig. 2); pronotal lobe white (Fig. 8); head from above markedly convergent posteriorly (Fig. 6); head entirely smooth and polished (Figs 2, 3 & 6); mesoscutum and scutellum with bronzy reflection in certain light; mesopleuron except triangular furrows smooth and shining (Fig. 8); inner orbits of eyes roundly convergent below (Fig. 2); mesonotum anteriorly half-mat, disc scattered with somewhat large shallow indistinctly-outlined punctures (Fig. 6); petiole longitudinally sparsely carinate with irregular



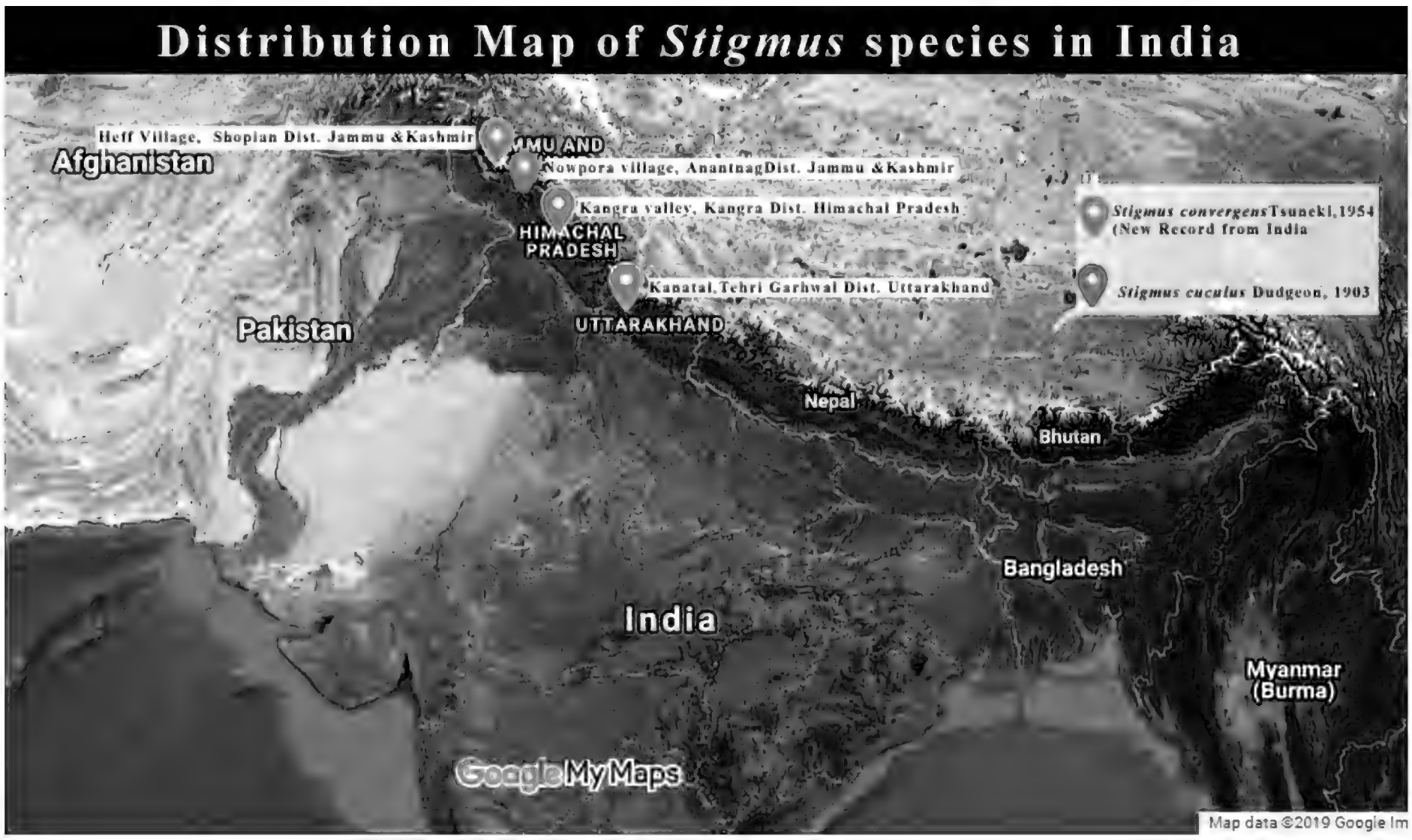








Figures 1-9: *Stigmus convergens* Tsuneki, female: **1**. Body, in profile view; **2.** Head, in frontal view; **3.** Head, in lateral view; **4.** Lower half of head showing clypeus and mandible; **5.** Antenna; **6.** Head and mesosoma in dorsal view; **7.** Fore wing; **8.** Mesosoma, in lateral view; **9.** Metanotum, propodeum, petiole and second tergite.



rugulose punctures in between (Fig. 9); pygidial area very minutely rugulose, half-mat.

Colour description: Body black and shining. Following whitish yellow: mandibles except apex and palpi. Following whitish: pronotal lobe. Following testaceous: scape of antennae wholly and flagellum beneath, tegulae, last metasomal tergum and sternum (except base), ovipositor and ovipositor sheath, apex of coxae, trochanters wholly, base and apex of all femora, fore tibia, mid tibia except inner surface, base of hind tibia broadly and all tarsi. Wings hyaline, veins and stigma dark brown. Sides of lower front, clypeus, mandibles, mesopleuron in part and apical metasomal segment with sparse short pubescence, hairs on anterior margin of clypeus longer.

Length (up to the apex of second tergite): 2.28 mm.

Discussion: The nominate subspecies differs from *Stigmus convergens ami* in having: (1) on an average head more strongly convergent backwards, (2) petiole relatively shorter and (3) punctures on head and mesoscutum slightly more pronounced (Tsuneki, 1971).

Material examined: India: Jammu & Kashmir, Shopian district, Heff village, 1 female, 17.vii.2018, Coll. Altaf Hussain Sheikh, ZSIK Regd. No. ZSI/WGRC/IR/INV.11864; Jammu & Kashmir, Anantnag district, Nowpora village, 3 females, 4.ix.2015, Coll. Abdul Lateef Khanday, ZSIK Regd. Nos. ZSI/WGRC/IR/INV.13006-13008; Uttarakhand, Tehri Garhwal district, Kanatal village, 1 female, 20.vii.2019, Coll. P. Girish Kumar, ZSIK Regd. No. ZSI/WGRC/IR/INV.13005.

Distribution: India: Jammu & Kashmir (**new record**) and Uttarakhand (**new record**); Japan, Russia, North Korea, Taiwan, China.

Key to Indian species of *Stigmus*

1. Apex of clypeus deeply emarginate (Fig. 4); paraorbital sulcus absent (Fig. 2); pronotal lobe white (Fig. 8).....***S. convergens* Tsuneki, 1954**
— Apex of clypeus not emarginate, but truncate (as in Fig. 2 of Pulawski and Gracy, 2018: 334); paraorbital sulcus present on the frons (as in Fig. 1 of Pulawski and Gracy, 2018: 334); pronotal lobe black..... ***S. cuculus* Dudgeon, 1903**

Acknowledgements

The authors are grateful to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata, for providing facilities and encouragements. We express our sincere gratitude to Wojciech Pulawski, California Academy of Sciences for helping us with the confirmation of our species identification.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)

HALTERES, Volume 10, 35-39, 2019
doi: 10.5281/zenodo.3553175

A new species of *Asyndetus* Loew, 1869 from Iran (Diptera: Dolichopodidae)

***Igor Ya. Grichanov[1], Shoreh Rezaei[2]**

[1]*All-Russian Institute of Plant Protection, Podbelskogo 3, 196608, St.Petersburg-Pushkin, Russia.*
[2]*Department of Entomology, Jahrom Branch, Islamic Azad University, Jahrom, Iran.*

(Email: grichanov@mail.ru)

Abstract

A new species, *Asyndetus fallahzadehi* sp. n. from Fars Province of Iran is described and illustrated. A key to *Asyndetus* species of Iran and neighbouring countries is compiled for the first time.

Keywords: *Asyndetus, new species, Iran, Fars, key.*

Received: 15 April 2019; Revised: 26 November 2019; Online: 21 December 2019

Introduction

The genus *Asyndetus* Loew, 1869 is a cosmopolite, with 110 species widely distributed across arid and subtropical zones of all zoogeographical regions. Fourteen species are recorded from Afrotropics, and 24 species are known from the Palaearctic Region (Grichanov, 2017). Negrobov (1973) reviewed Palaearctic *Asyndetus* species. Subsequently Bickel (1996) redescribed the genus, and Grichanov (2013) reviewed the Afrotropical fauna.

Considering the genus *Asyndetus*, Iranian fauna is poorly known. Negrobov (1973) mentioned a specimen of *A. connexus* (Becker, 1902) identified by Becker and collected from Iran, but not giving original material. Nevertheless, Becker and Stein (1913) did not include this species into the first contribution to the Dolichopodidae fauna of Iran. Widely distributed in the Old World, *A. latifrons* (Loew, 1857) has been only recently found in the country (Kazerani *et al*., 2014). The faunas of adjacent countries are unknown (Afghanistan, Pakistan, Kuwait, Oman, Qatar, UAE), or each numbers only 1-2 *Asyndetus* species (Grichanov, 2017). Our recent investigation has revealed three species of the genus in the Fars Province of Iran (Rezaei *et al*., 2019). *Asyndetus albifrons* Loew, 1869, and *A. chaetifemoratus* Parent, 1925 have been found in the country for the first time. The third species is described here as new for science.

Materials and Methods

A new *Asyndetus* species discovered is described here, and illustrated with a ZEISS Discovery V-12 stereo microscope and an AxioCam MRc5 camera. Genitalia preparations have been photographed with a ZEISS Axiostar stereo microscope and an AxioCam ICc3 camera. Morphological terminology and abbreviations follow Cumming and Wood (2017) and Grichanov and Brooks (2017). Body length is measured from the base of the antenna to the posterior tip of epandrium. Wing length is measured from the base to the wing apex. The types of new species and other materials examined are housed at the Zoological Museum of Moscow State University, Moscow, Russia (ZMUM), the Zoological Institute of the Russian Academy of Sciences, St. Petersburg (ZIN) and the Department of Entomology, Jahrom Branch, Islamic Azad University, Jahrom, Iran (JIAU).

Taxonomy

Genus *Asyndetus* Loew, 1869

Remarks: See Negrobov (1973), Bickel (1996) and Grichanov (2013) for diagnosis of the genus *Asyndetus*. Males differ from females usually in such male secondary sexual characters (MSSC) as densely pollinose frons

and face, absence of claws on all or some tarsi, enlarged pulvilli on all or some tarsi, sometimes modified tarsomeres, elongate ventral setae on all or some femora.

***Asyndetus fallahzadehi* Grichanov sp. n.**
(Figs. 1–5)

urn:lsid:zoobank.org:act:F8B914C3-7FE2-413F-BEBD-F4A4239ED19B

Description: *Male* (Fig. 1): ***Head*** (Fig. 2): Frons bronze-black, densely whitish grey pollinose; face shining greenish blue, densely white pollinose (MSSC), broad, weakly narrowed, slightly higher than wide under antennae (20/15); occiput concave, violet-black, grey pollinose; pair of long ocellar, pair of long vertical, and pair of shorter postvertical bristles; postocular setae relatively short, uniserial, black above, whitish below; lower postcranium with several long white setae; eyes with microscopic white hairs. Antennae inserted in about middle of head, black, as long as height of head; scape long, bare; pedicel covered with dorsal and ventral setulae, with short inner projection distally; postpedicel subtriangular, with right-angular apex, as long as high, covered with short hairs; arista-like stylus mid-dorsal, with microscopic hairs; length ratio of scape to pedicel to postpedicel to stylus, 11/9/11/47. Palpus short, yellow, with several hairs and 2 black apical setae; proboscis short, black, with short black hairs.

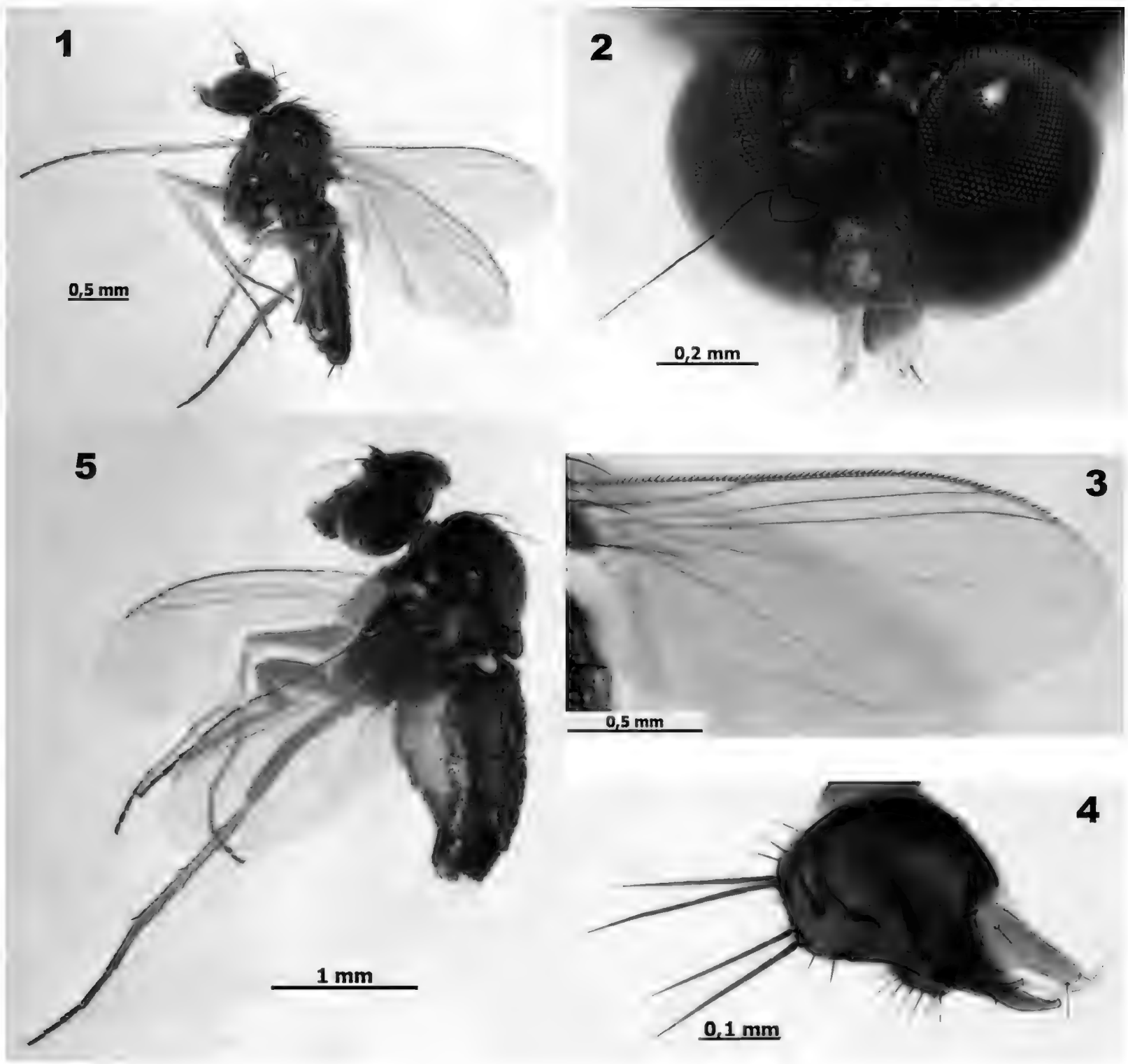
Thorax: Mesonotum metallic greenish blue; pleura violet-green, weakly pollinose; four pairs of dorsocentral bristles; acrostichals biserial, small, 3 or 4 pairs; scutellum with two long strong setae and two short lateral hairs.

Legs: Coxae mainly black, with yellow ventral apices; legs mainly yellow; fore femur often brownish dorsally; mid femur often brown in middle; hind femur blackish on distal half or third; hind tibia dark at apex; fore and mid tarsi black from apex of basitarsus; hind tarsus black except base of basitarsus yellow; fore coxa anteriorly with black hairs and setae of various length; mid coxa with black setae anteriorly and apically; mid and hind coxae with black external seta; fore femur with about 5 posteroventral setae on distal half, about as long as femur diameter (MSSC); mid femur with short setulae, with at most 2 ventral setae, half as long as femur diameter; hind femur with double row of 3 to 5 fine ventral setae, about as long as femur diameter (MSSC) and 2 or 3 fine subapical anterior setae; fore tibia without conspicuous setae; mid tibia with 2 long anterodorsal, 2 short posterodorsal bristles; hind tibia with 2 anterodorsal, 3-5 posterodorsal bristles; all tibiae with apical setae; fore tarsus with 1 claw, with 2 enlarged pulvilli (MSSC); other tarsi simple, with short claws and small pulvilli; podomeres (from tibia to fifth tarsomere) length ratio (in mm): fore leg: 0.73/0.47/0.20/0.16/0.12/0.10, mid leg: 0.81/0.52/0.25/0.18/0.13/0.11, hind leg: 1.06/0.33/0.29/0.17/0.12 /0.12.

Wing (Fig. 3): Hyaline, veins brown; R_1 ending at basal 1/3 of wing; ratio of costal section between R_{2+3} and R_{4+5} to that between R_{4+5} and M_{1+2}, 28/39. R_{2+3} and R_{4+5} straight; M_{1+2} with bend in middle of apical part, strongly weakened at bend and somewhat weakened in apical part; section of M_{1+2} between posterior cross-vein (*dm-m*) and bend slightly longer than that between bend and wing margin (80/73); *dm-m* located before level of R_1; ratio of apical portion of M_4 to *dm-m*, 97/12; anal vein distinct, anal lobe well developed, anal angle right; calypter yellow, with simple yellow cilia; halter yellow.

Abdomen: Black, with black setation; sterna 4-5 developed, setose; tergum 6 glabrous; sternum 6 and segment 7 reduced; segment 8 large, rounded, with four strong black bristles; hypopygium (Fig. 4) black, small, partly concealed; epandrium flattened laterally, with left lateral foramen; hypandrium fused with epandrium, simple, short, triangular (ventral aspect); phallus long and thin, simple; a pair of long symmetrical epandrial lobes originating near base of hypandrium, broad at base, narrow on apical half, with 2 setae on rounded apex and 1 pedunculate seta at base; surstylus bilobate, more or less straight, narrow; ventral lobe of surstylus slightly curved, bearing some short setulae and one strong middorsal seta; dorsal lobe half as long as ventral lobe, bearing short apical seta; postgonite narrow, curved ventrally, reaching apex of dorsal lobe of surstylus; cercus black, small, rounded, bearing short black setae.

Measurements (mm): Body length in ethanol 2.5-2.6, wing length/width 2.3/0.9, antenna length 0.6.



Figs. 1-5. *Asyndetus fallahzadehi* Grichanov, **sp. n.** (in ethanol): **1.** Male habitus**; 2.** Head; **3.** Wing; **4.** Hypopygium, lateral view (after maceration); **5.** Female habitus.

Female (Fig. 5): Similar to male except lacking MSSC. Femora entirely yellow. Podomeres (from tibia to fifth tarsomere) length ratio (in mm): fore leg: 0.78/0.45/0.17/0.15/0.11/0.11, mid leg: 0.98/0.58/0.24/0.20/0.11/0.11, hind leg: 1.19/0.38/0.31/0.20/0.12 /0.12.

Measurements (mm): Body length in ethanol 3.0, wing length/width 2.5/1.0.

Material examined: ***Holotype*****:** ♂, Iran: Fars, Province, Larestan, 30.iii–9.iv.2018, 54°26'1.36"E, 27°31'55.4"N, leg. Shoreh Rezaei [ZMUM; dried and mounted on pin].

Paratypes (in ethanol): 1♂, Dalin, 52°07'54.7"E, 30°02'15.0"N, 1–7.v.2018; 2♂, same data, 1–7.v.2018; 2♀, same data, 8–14.v.2018; 1♀, same data, 15–21.v.2018; 6♂, 1♀, Dasht–e Arzhan, 51°59'3.439"E, 29°39'39.047"N, 24–30.iv.2018; 2♂, 2♀, same data, 1–7.v.2018; 1♂, same data, 8–14.v.2018; 4♂, same data, 15–21.v.2018; 2♂, 1♀, same data, 22–28.v.2018; 6♂, 10♀, Larestan, 30.iii.2018–9.iv.2018, 54°59'2.3"E, 27°32'6.7 "N; 2♂, 4♀, Larestan, 30.iii–9.iv.2018, 54°26'1.36"E, 27°31'55.4"N; 7♂, 1♀, same data, 10–20.iv.2018; 2♂, same data, 21–30.iv.2018; 1♀, same data, 1–11.v.2018; 1♂, same data, 12–21.v.2018; 1♂, Shiraz, 52°28'9.147"E, 29°36'52.373"N, 24–30.iv.2018; 2♂, same data, 1–7.v.2018; 2♂, 2♀, same data, 8–14.v.2018. [same collector; JIAU, ZIN, ZMUM; 1♂ in glycerol, mounted in vial on pin; 1♀ dried and mounted on pin].

Diagnosis: The new species is close to *Asyndetus chaetifemoratus* Parent, 1925, and *A. albifacies* Parent, 1929 (Negrobov, 1973; Grichanov, 2013), differing from these species in mainly yellow femora in male and entirely yellow femora in female; male fore femur often brownish dorsally; mid femur often

brown in middle; hind femur blackish on distal half or third. Femora are mostly dark in *A. chaetifemoratus* and *A. albifacies*. In addition, in male *A. chaetifemoratus*, all femora have complete rows of long ventral setae, at least as long as femur diameter; anterior tibia has short, but strong posteroventral seta at distal 1/5. Male *A. albifacies* has no long ventral setae on anterior tibia, bearing two complete ventral rows of long setae on hind tibia. In contrast, *A. fallahzadehi* **sp. n.** males bear relatively short ventral setae on fore and hind femora, about half as long as corresponding femur diameter.

Etymology: This species is named in honor of Iranian entomologist Dr. Majid Fallahzadeh (Department of Entomology, Jahrom Branch, Islamic Azad University, Jahrom).

Key to *Asyndetus* species of Iran and neighbouring countries
(males only)

1. Wing vein *dm-m* absent 2
– Wing vein *dm-m* present 4
2. Apical part of M_{1+2} distinctly broken; coxae and femora dark; 1.7-2.2mm.....***A. separatus*** **(Becker)**
– M_{1+2} not broken, only attenuated, often faded; anterior coxa and all femora yellow.....3
3. Antenna longer than face height; postpedicel distinctly longer than high; 1.5-2.3mm.....***A. longicornis*** **Negrobov**
– Antenna shorter than face height; postpedicel not longer than high; 2.0mm .....***A. connexus*** **(Becker)**
4. Palpus dark 5
– Palpus yellow 8
5. Male posterior tibia with row of very long black ventral setae along entire length; M_{1+2} stepwise broken; 2.25mm...***A. varus*** **Loew**
– Posterior tibia without row of long ventral setae.....6
6. Section of M_{1+2} between posterior cross-vein (*dm-m*) and bend about as long as that between bend and wing margin; epandrial lobe short and wide, distinctly shorter than surstylus, bearing two apical setae; 2–3 mm .....***A. latifrons*** **(Loew)**
– Section of M_{1+2} between *dm-m* and bend distinctly longer than that between bend and wing margin.....7
7. Frons silvery-white pollinose; epandrial lobe present, long and thin; 2.5 mm ....***A. albifrons*** **Parent**
– Frons grey pollinose; epandrial lobe reduced; 2.5–3 mm...***A. virgatus*** **Curran**
8. Posterior femora without long ventral setae 9
– Posterior femora with long ventral setae, at least half as long as diameter of femur in middle.....10
9. Femora dark; M_{1+2} interrupted(?); *dm-m* positioned at extreme base of wing; 2.0-2.5mm.....***A. transversalis*** **(Becker)**
– Femora yellow; M_{1+2} undulate; 2.2-2.5mm .....***A. izius*** **Negrobov**
10. Femora mainly yellow; fore femur often brownish dorsally; mid femur often brown in middle; hind femur blackish on distal half or third .....***A. fallahzadehi*** **sp.n.**
– Femora mostly dark 11
11. All femora with complete rows of long ventral setae, at least as long as femora diameter; anterior tibia with 1 anterodorsal, 1 posterodorsal and 1 posteroventral setae; 3.0-3.5mm.....***A. chaetifemoratus*** **Parent**
– Only posterior femora with 2 complete ventral rows of long setae; anterior tibia without setae; 2.5mm.....***A. albifacies*** **Parent**

Discussion

Asyndetus species are common in subtropics and tropics of the Old World. The Palaearctic species of the genus are confined mainly to the Mediterranean and Central Asian regions. Only *A. latifrons* (Loew) is widely distributed in the Afrotropical, Palaearctic and Oriental Regions (Grichanov, 2013).

Asyndetus fallahzadehi **sp. n.** is found only in the Fars Province, being probably endemic to the South Iran. The latter territory is traditionally included in the Palaearctic zoogeographical region, but having a significant Afrotropical element in its fauna (Kryzhanovsky, 2002).

As a result, the long-legged fly fauna of Fars Province comprises of 6 nominal species (see Rezaei *et al.*, 2019), and the genus *Asyndetus* includes 5 known species from Iran.

Acknowledgments

The research was supported by the Islamic Azad University, Jahrom Branch, Jahrom, Iran and the All-Russian Institute of Plant Protection project N 0665-2018-0002,

St.Petersburg-Pushkin, Russia. Drs. O.P. Negrobov (Voronezh, Russia) and M. Fallahzadeh (Jahrom, Iran) kindly commented on earlier drafts of the manuscript.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)

HALTERES, Volume 10, 40-47, 2019
doi: 10.5281/zenodo.3589977

Redescription of three species of genus *Stomorhina* Rondani (Diptera: Calliphoridae) from India

***Inderpal Singh Sidhu[1] and Devinder Singh[2]**

[1]*Department of Zoology, SGGS College, Sector 26, Chandigarh, India-160019.*
[2]*Department of Zoology and Environmental Sciences, Punjabi University, Patiala-147002, India.*

(Email: inderpalsidhu76@yahoo.co.in)

Abstract

Three Indian species of genus *Stomorhina* Rodani are redescribed in detail with illustrations of male and female genitalia, taxonomic history and updated distribution records.

Keywords: *Stomorhina,* Calliphoridae, Diptera, India

Received: 25 May 2019; Revised: 20 December 2019; Online: 21 December 2019

Introduction

Senior White *et al.* (1940) recognized 15 species belonging to the genus *Stomorhina* from British India. However, lot of changes have occurred since then and now the genus is represented by 16 species from the Oriental region including 8 from India (Bharti, 2011) that includes 3 from the area under present investigations. The genus is not easy to distinguish from the genera *Idiella* Brauer *et* Bergenstamm and *Rhinia* Robineau-Desvoidy and according to Kano and Shinonaga (1968) 'There is no obvious reason for separating these three genera". However, further interpretations can be made only after studying more material, including the types. The three species have been identified following the key given by Bharti (2016).

Abbreviations used

AC - Acrostichal bristles; ACP - Acrophalius; AP - Anterior paramere; AS - Apicoscutellar bristles: BM - Basal membrane; C - Cerci; DC - Dorsocentral bristles; DS - Discoscutellar bristles; H - Humeral bristles; HU - Humerus; lA - Intra-alar bristles; LS - Lateroscutellar bristles; NP - Notopleural bristles; PAB - Postalar bristles; PC - Postalar callus; PH - Posthumeral bristles; PL - Paralobi; PP - Posterior paramere; PPH - Paraphallus; PS - Phallosorne; PSB - Presutural bristles; S_1 - Sternite 1; S_2 - Sternite 2; S_3 - Sternite 3; S_4 - Sternite 4; S_5 - Sternite 5; S_6 - Sternite 6; S_7 - Sternite 7; S_8 - Sternite B; S_9 - Stemite 9; SA - Supra-alar bristles; SCT - Scutellum; T_6- Tergite 6; T_7 - Tergite 7; T_8 - Tergite 8; T9 - Tergite 9; TH - Theca; TS - Transverse sufure; V - Ventralia

Genus *Stomorhina* Rondani, 1861

Idia Meigen in Wiedemann, 1820. *Nova. Dipt. Gen.*: 21.

Stomorhina Rondani, 1861. *Dipt. Ital. Prod.* 4: 9. type species *Musca lunata* Fabricius, 1805.

Stomathorrhina Bezzi, 1906. *Z. Hym. Dipt.* 4:53.

Stomatorrhina Kertesz, 1907. *Cat. Palae. Dip.* 3: 523.

Stomatorhina Malloch, 1926. *Ann. Mag. Nat. Hist.* (9) 18: 499.

Idiella Brauer et Bergenstamm, 1889. *Denkschr. Akad. Wiss. Wien.* 6: 154.

Idielliopsis Townsend, 1917. *Rec. Ind. Mus.* 13: 190.

Eudiella Townsend, 1917. *Rec. Ind. Mus.* 13: 192.

Stomorhina Rondani: Senior-White *et al.,* 1940. *Fauna Brit. India, Dipt.* 6: 190.

Diagnostic characters: Eyes bare, subholoptic in male, upper facets slightly enlarged; parafacialia metallic black; facial carina present; epistome strongly projecting; genae metallic black anteriorly; arista plumose on dorsal side only; thorax variously coloured, black, olive or cupreous green, with piliferous spots; pleura with or without piliferous spots; propleuron, suprasqumal ridge and postalar declivity bare; mesopleuron with 2-5 posterior bristles; acrostichals 0+0-2; dorsocentrals 0+0-2; intra-alars 0+0-2; presutural present; humerals 1-3; posthumeral 1; supra-alars 2-3; post-alars 2; notopleurals 2; lateroscutellars 1-2; apicoscutellar 1; discoscutellar absent; sternopleurals 1+1; prostigmatic bristle absent; R1 bare; R4+5 setulose at least on basal node; first posterior cell (R5) slightly open or closed, not petiolate; thoracic squama bare dorsally; legs brown to black; hindtibia without row of short bristles, only 2-3 outstanding ones present; abdomen same coloured as thorax, in some species with yellow or reddish markings.

Distribution: Entire Oriental Region, most parts of Palaearctic, Afrotropical, Neartic and Australian regions.

***Stomorhina xanthogaster* (Wiedemann, 1820)**

(Figs.1-7)

Idia xanthogaster Wiedemann, 1820. *Nov. Dipt. Gen.,* p. 21. type loc., Java, Indonesia.

Idia australis Walker, 1849. *List. Dipt. Brit. Mus.* 4: 809.

Idelliopsis similis Townsend, 1917. *Rec. Ind. Mus.* 13(4): 190.

Idiella xanthogaster (Wiedemann) : Seguy, 1928. *Encyl. Ent.* (A) IX: 183.

Rhinia majuscula Villeneuve, 1932. *Bull. Ann. Soc. Ent. Belg.* **71** :245.

Stomorhina xanthogaster (Wiedemann): Bezzi, 1927. *Bull. Ent. Res.* 17: 234.

Rhinia xanthogaster (Wiedemann): Peris 1952. *An. Aula Dei.* 3(1): 39.

Idiellopsis xanthogaster (Wiedemann): James, 1977. *Cat. Dipt. Orient. Reg.* 3: 546.

Stomorhina xanthogaster (Wiedemann): Kurahashi, 1987. *Occ. Publ. Ent. Soc. Japan* 1: 84.

MALE : Body length 8.0 - 9.5 mm.

Head: Eyes bare, subholoptic, upper facets enlarged; frons dark brown to black, wider than parafrontalia; parafrontalia white, with shining black spots; frontal bristles well developed; fronto-orbital bristles absent; ocellus with ocellar and postvertical bristles; vertical and outervertical bristles present, prevertical bristles absent; parafacialia metallic black; face shining black, bare; facial carina present; epistome, medianae and jowls shining brown, bare, except jowls with brownish hair; genae and postgenae shining black with black hair; vibrissae present well above oral margin; peristomal bristles well developed; postorbit black with silver tomentum, bare; occiput metallic black, with thick golden hair; antennae brown; 1st segment setulose while 2nd segment with one long bristle; length of 3rd segment about 4X that of 2nd; arista brown, long plumose; palpi black with bristles present all over.

Thorax: Dark green with greyish white dusting; humerus and postalar callus concolorous with dorsum; prothoracic spiracle yellow; propleuron bare and prosternum hairy; postalar declivity bare; supraspiracular convexity bare; suprasquamal ridge with anterior tuft.

Chaetotaxy (Fig. 4)**:** Acrostichals 0+1; dorsocentrals 0+2; intra-alar 0+1; presutural present; humerals 3; posthumeral 1; supra-alars 3; post-alars 2; notopleurals 2; lateroscutellars 2; apicoscutellar 1; discoscutellar absent; sternopleurals 1+1; propleural present and prostigmatic absent.

Wings: Yellow, slightly infuscated at base; veins brown; stem vein (R) setulose; R1 bare; R4+5 setulose at basal node on both dorsal and ventral sides; first posterior cell (R5) closed; epaulet and basicosta dark brown; subcostal sclerite reddish brown, bare; alar and thoracic squamae deep yellow with yellowish marginal cilia, bare dorsally; halteres yellow.

Legs: Brown to black; tibiae and tarsi pale brown; fore- and hind femora with bristles on both dorsal and ventral sides while midfemur with bristles on ventral side only; fore tibia with 2 bristles at middle and 3 at apex; midtibia with one bristle at middle and 2 at apex; hindtibia with 3 bristles at middle and 2 at apex.

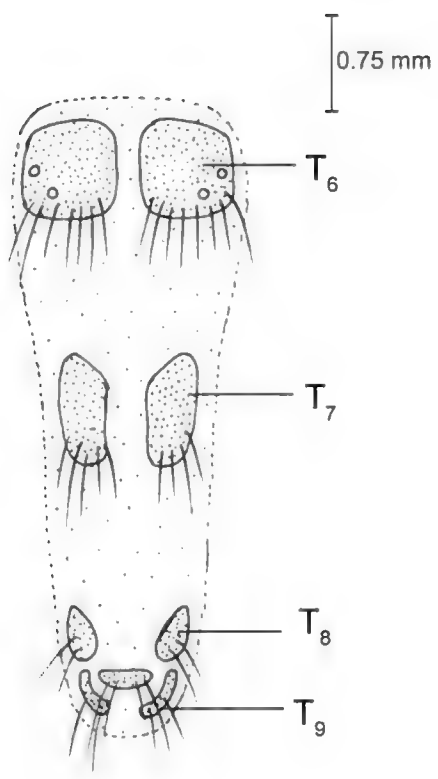

FIG. 1

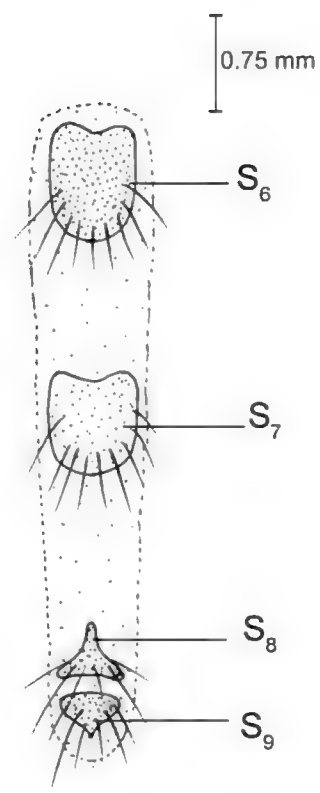

FIG. 2

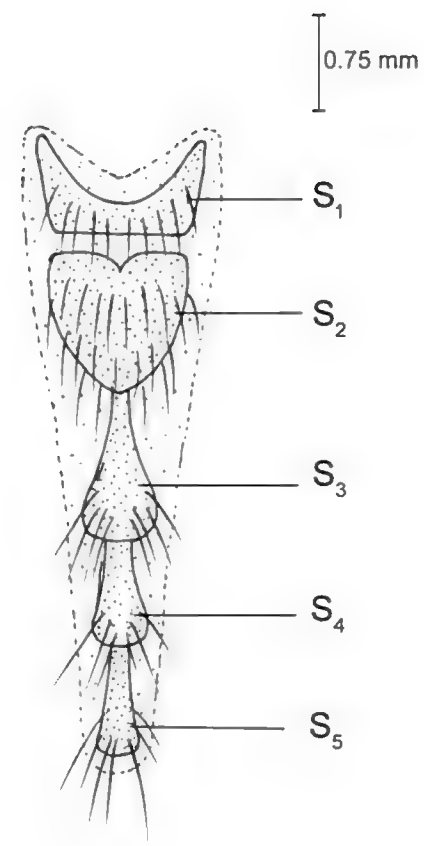

FIG. 3

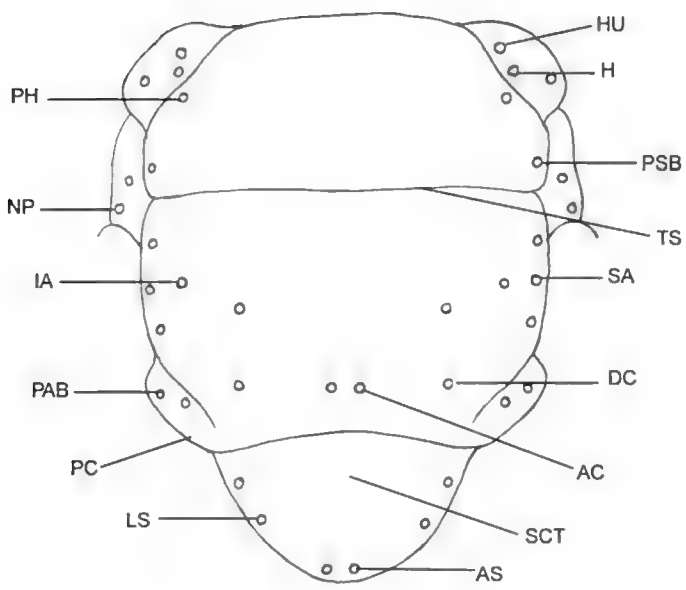

FIG. 4

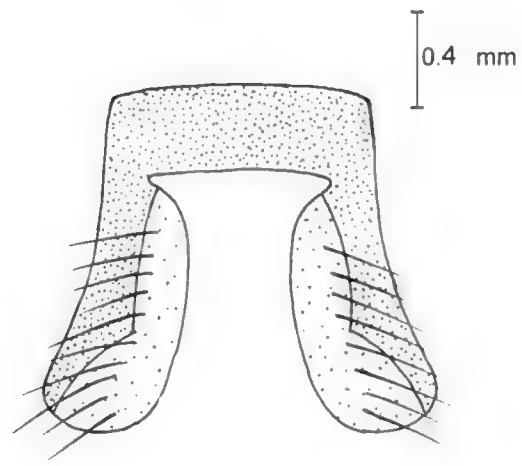

FIG. 5

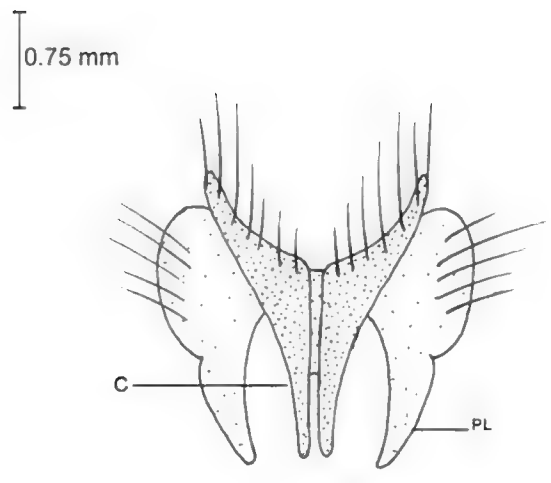

FIG. 6

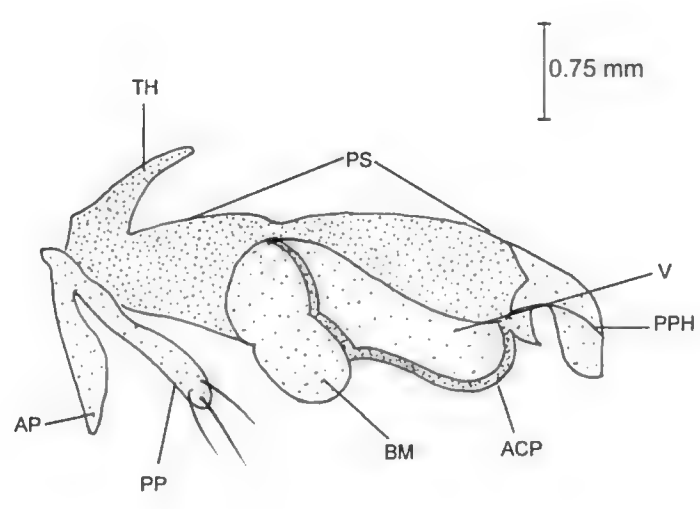

FIG. 7

Figs. 1-7. *Stomorhina xanthogaster*: **1.** Dorsal view of ovipositor; **2.** Ventral view of ovipositor; **3.** Sternites I-V of female; **4.** Dorsal view of chaetotaxy of thorax (Diagrammatic). **5.** Sternite V of male; **6.** Cerci and paralobi; **7.** Aedeagus and parameres.

Abdomen: Reddish orange, with a black median stripe; tergites 4 and 5 blackish at posterior end; tergites 2-5 with strong marginal bristles; sternites 1-5 with long black hair; hypopygium conspicuous.
Male genitala: Fifth sternite (Fig. 5), Cerci and paralobi (Fig. 6), Aedeagus and parameres (Fig. 7)

FEMALE: Body length 9.0 - 10.0 mm.
Similar to the male except: eyes dichoptic, frons wider, fronto-orbital bristles present, abdomen without black median stripe, tergites 4 and 5 without black band at posterior margin, midtibia with series of posterior marginal bristles. Sternites 1-5 (Fig. 3).
Female genitalia: Dorsal view of ovipositor (Fig. 1), Ventral view of ovipositor (Fig. 2).

Material examined: Uttaranchal: Almora-1650m (5♂♂, 11♀♀) 10.x.2001. Coll. Inderpal Singh Sidhu.

Distribution: India (Assam, Bihar, Madhya Pradesh, Sikkim, Uttaranchal), Celebes, Indonesia, Malaysia, Nepal, Sri Lanka, Taiwan, Saudi Arabia, China, Australia and New Guinea.

Holotype depository: ZSI, Calcutta, India.

Remarks: This species is different from the other species of the genus Stomorhina because of having first posterior cell (R5) petiolate and sternopleura densely yellow dusted. It has been reported from many Indian states and is widely distributed in the Oriental region.

***Stomorhina discolor* (Fabricius, 1794)**
(Figs. 8-14)

Musca discolor Fabricius, 1794. *Entom. Syst.,* 4: 320. type loc., India Orient.
Idia metallica Macquart, 1835. *Hist. Nat. Ins. Dipt.,* 2: 246.
Idia quadrimaculata Macquart, 1851. *Mem. Soc. Agric. Lille* 1851: 213.
Idia aequalis Walker, 1859. *J. Proc. Linn. Soc. Lond. Zool.* 3: 103.
Idia cincta Bigot, 1874. *Ann. Soc. Ent. Fr.,* (5) 4: 258.
Stomorhyna muscina Rondani, 1875. *Ann. Mus. Civ. Stor. Nat. Giacomo Doria*, 7: 429.
Stomorhina scalaris Bigot, 1887. *Bull. Soc. Zool. Fr.* 12: 591.
Euidilla discolor *var. nigripes* Senior-White, 1922. *Mem. Dept. Agric. Ind. (Ent. Ser.)* 7: 167.
Stomatorrhina discolor (Fabricius) : Wu, 1940. *Cat. Ins.Sin.,* 5: 375.
Stomorhina discolor (Fabricius) : Senior-White *et al.*, 1940. *Fauna Brit. India, Dipt.,* **6** : 192.
Stomotorrhina muscina Rondani : Henning, 1941. *Ent. Beih.* 8: 181.
Rhinia discolor (Fabricius): Peris, 1952. *An. Aula Dei,* **3**(1) : 32.
Stomorhina discolor (Fabricius): James, 1977. *Cat. Dipt. Orient. Reg.,* **3**: 557.

MALE: Body length 5.4 - 6.5 mm.
Head: Eyes bare, subholoptic, facets larger at anterior end than posterior end; frons reddish brown, bare, wider than parafrontalia, forms a thin line as it approaches vertex; parafrontalia silvery grey with shining black spots; frontal bristles weak; fronto-orbital bristles absent; ocellus with weak ocellar and postvertical bristles; vertical and outervertical bristles absent, prevertical bristles present; parafacialia shining metallic black, bare; face, epistome, medianae and jowls shining black, bare; facial carina present; epistome strongly projecting; genae metallic black anteriorly; postgenae golden, covered with golden hair; vibrissae present well above oral margin; persitomal bristles very weak; postorbit golden, bare; upper part of occiput shining black, bare, lower part golden with golden hair; 1st and 2nd antennal segments orange, 2nd with one long bristle, 3rd segment orange with silver dusting, length of 3rd segment about 4X that of 2nd; arista light brown, plumose on dorsal side only; palpi brown, bare.
Thorax: Ground colour green, thickly grey dusted, covered with black small spots; pleura with golden yellow hair; humerus and postalar callus concolorous with dorsum; prothoracic spiracle yellow; propleuron bare; prosternum with yellow fine hair; postalar declivity bare; supraspiracular convexity bare; suprasquamal ridge bare.
Chaetotaxy (Fig. 11) : Acrostichals 0+1; dorsocentrals 0+2; intra-alar 0+1; presutural

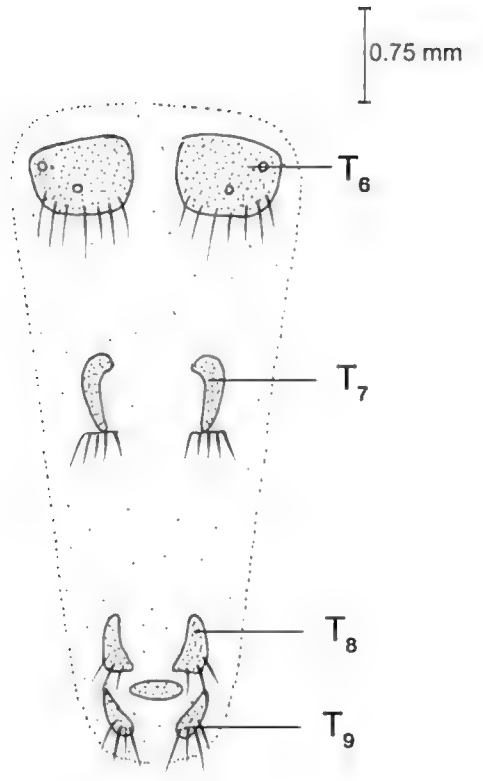

FIG 8

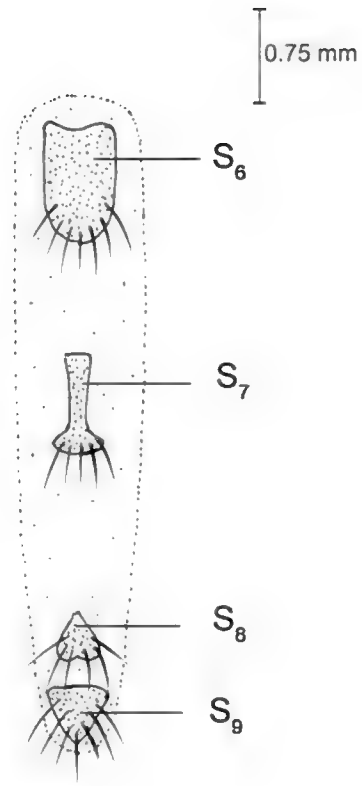

FIG 9

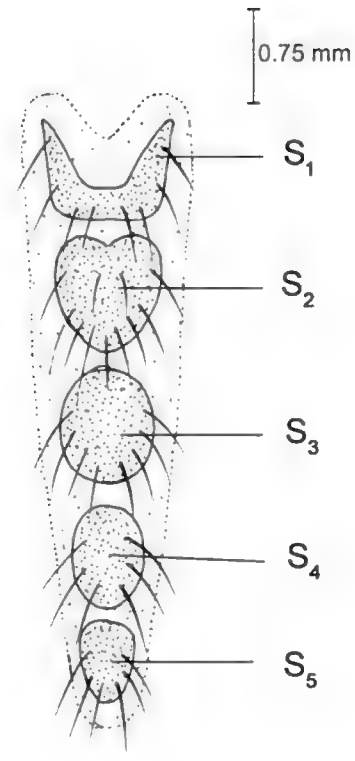

FIG 10

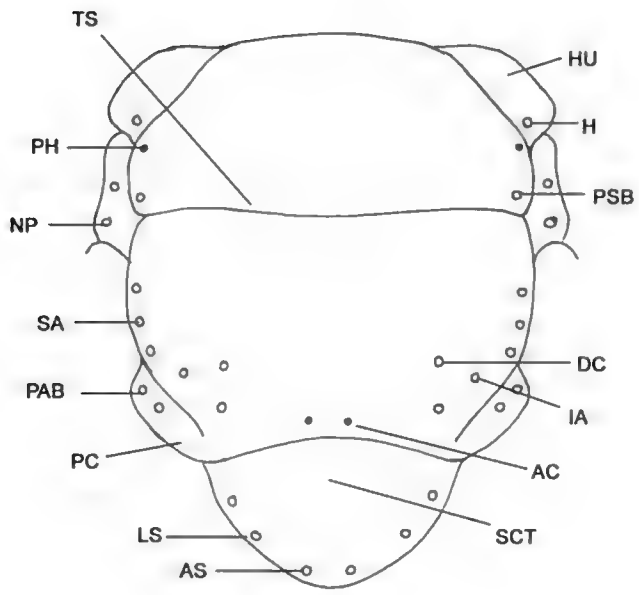

FIG 11

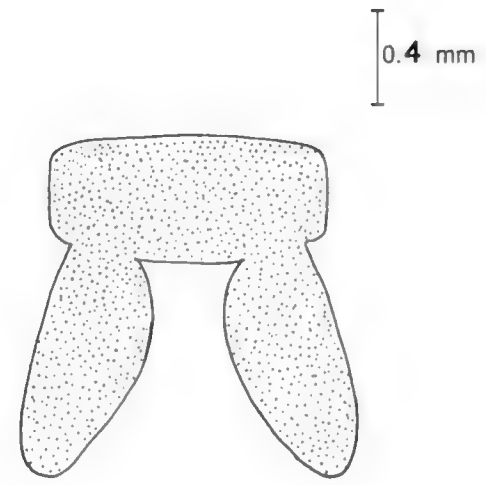

FIG 12

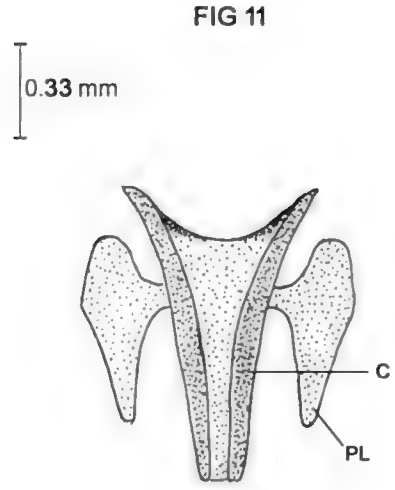

FIG 13

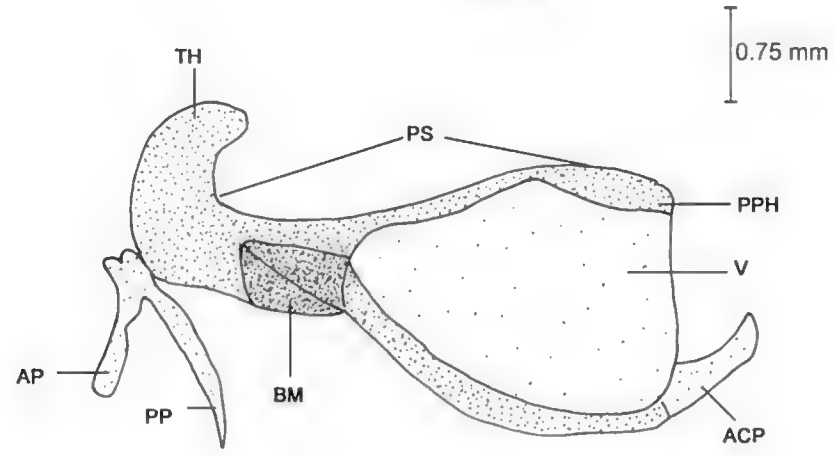

FIG 14

Figs. 8-14. *Stomorhina discolour*: **8.** Dorsal view of ovipositor; **9.** Ventral view of ovipositor; **10.** Sternites I-V of female; **11.** Dorsal view of chaetotaxy of thorax (Diagrammatic); **12.** Sternite V of male; **13.** Cerci and paralobi; **14.** Aedeagus and parameres.

present; humeral 1; posthumeral 1; supra-alars 3; post-alars 2; notopleurals 2; lateroscutellars 2; apicoscutellar 1; discoscutellar absent; sternopleurals 1+1; propleural present; prostigmatic absent.

Wings: Slightly hyaline with yellowish tinge; veins yellowish; stem vein (R) setulose; R1 bare, R4+5 setulose at basal node only; first posterior cell (R5) slightly open; epaulet brown; basicosta yellow; subcostal sclerite brown with fine black pubescence; alar squama brown on dorsal side, golden on ventral side, bare; thoracic squama golden, bare; both squamae with yellowish marginal cilia; halteres brown.

Legs: Brownish yellow except femora and tarsi which are brown; foretibia with 2 bristles at middle and 2 at apex; midtibia with 3 bristles at middle and 2 at apex; hindtibia with 2 bristles at middle and 1 at apex.

Abdomen: Ovoid, brown bands at posterior margin of each segment; tergites 2 and 3 yellow with brownish posterior bands and weak marginal bristles; tergites 4 and 5 shining dark brown with weak marginal bristles; sternites 1-5 with golden hair; hypopygium conspicuous.

Male genitalia: Fifth sternite (Fig. 12), Cerci and paralobi (Fig. 13), Aedeagus and parameres (Fig. 14)

FEMALE : Body length 6.0 - 6.3 mm.

Similar to male except: frons wider and parallel sided, fronto-orbital bristles present, outervertical bristles present. Sternites 1-5 (Fig. 10).

Female genitalia: Dorsal view of ovipositor (Fig. 8), Ventral view of ovipositor (Fig. 9)

Material examined: Haryana: Kalka-370m (3♂♂, 2♀♀) 3.x.1999; Himachal Pradesh: Shimla-2208m (1♂, 5♀♀) 28.iii.2002.

Distribution: India (Chandigarh, Haryana, Himachal Pradesh), Bangladesh, Fiji, Indonesia, Malaysia, Nepal, Phillipines, Sri Lanka, Thailand, Taiwan, China, Hong Kong, Japan and Australia.

Holotype depository: BMNH, London, England.

Remarks : This species is widely distributed in the Oriental, Palaearctic and Australian regions. Senior-White *et al.* (1940) reared it from the nest of an ant *Camponotus angusticollis*. Males often hover around under shady trees. According to Kurahashi and Fauran (1980), the larvae are predaceous upon immature stages of other insects.

Stomorhina melastoma (Wiedemann, 1830)

(Figs.15-21)

Idia melastoma Wiedemann, 1830. *Ausser. Zweifl. Insekt.* 2: 193. type loc., Buitonzorg, Indonesia.

Idia melanostoma Wiedemann, 1830. *Ausser. Zweifl. Insekt.* 2: 353.

Idiella purpurea Townsend, 1917. *Rec. Ind. Mus.* 13: 193.

Euidiella purpurea Townsend, 1917. *Rec. Ind. Mus.* 13: 193.

Idiella melanostoma Wiedemann: Malloch, 1926. *Ann. Mag. Nat. Hist.* (9) 18: 509.

Stomorhina melanostoma (Wiedemann): Senior-White *et al.,* 1940. *Fauna Brit. India, Dipt.* 6: 202.

Rhinia melanostoma melanostoma (Wiedemann) : Peris, 1952. *An. Aula Dei.* 3(1): 42.

Stomorhina melastoma (Wiedemann) : Dear, 1977. *Austr. J. Zool.,* 25: 795, figs. 24, 31, 39.

Rhinia melastoma (Wiedemann): James, 1977. *Cat. Dip. Orient. Reg.,* 3: 552.

Stomorhina melastoma (Wiedemann): Fan *et al.,* 1992. *Key Common Flies China,* 560pp.

MALE : Body length 7.5 - 8.0 mm.

Head: Eyes bare, subholoptic, facets slightly enlarged at anterior end; frons blackish, hairy; parafrontalia brownish with yellow tomentum, hairy; frontal bristles weak; fronto-orbital bristles present; ocellus with ocellar and postvertical bristles; vertical bristles present, outervertical bristles absent, prevertical bristles present; parafacialia blackish with silvery yellow band at upper part extending upto anterior part of face; face metallic black; facial carina present; epistome, medianae and jowls shining black, bare except jowls, with pale hair; genae and postgenae blackish with yellow tomentum with golden hair; vibrissae present well above oral margin; peristomal bristles well developed; postorbit silvery grey, bare; occiput shining

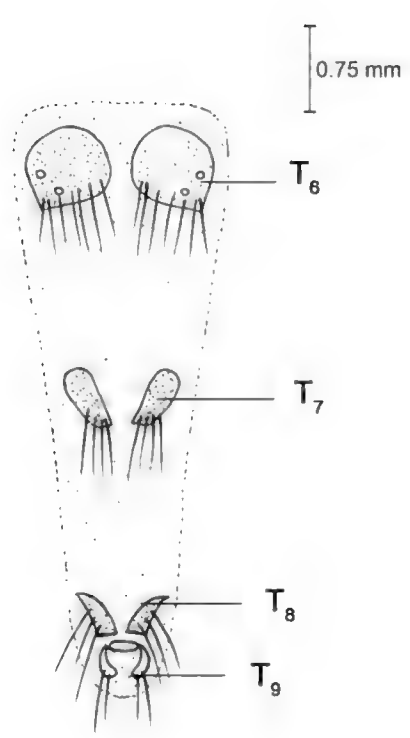

FIG 15

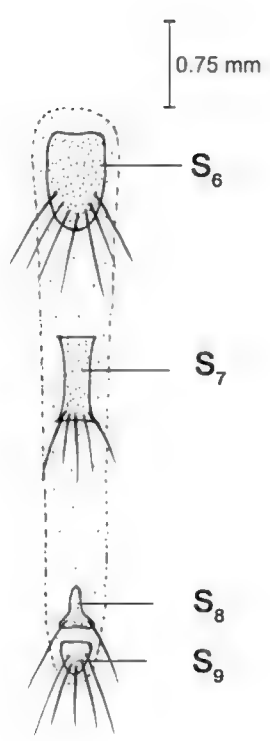

FIG 16

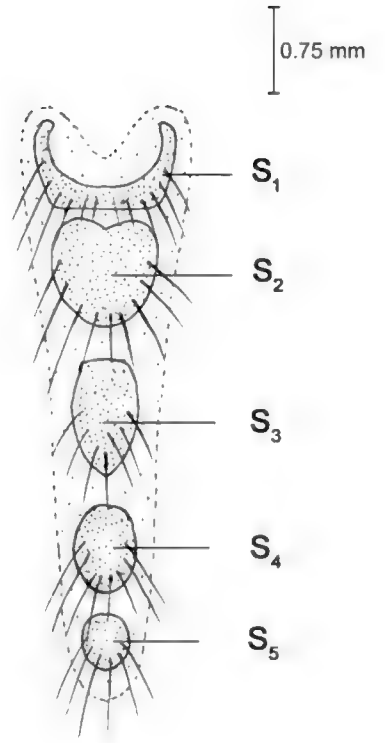

FIG 17

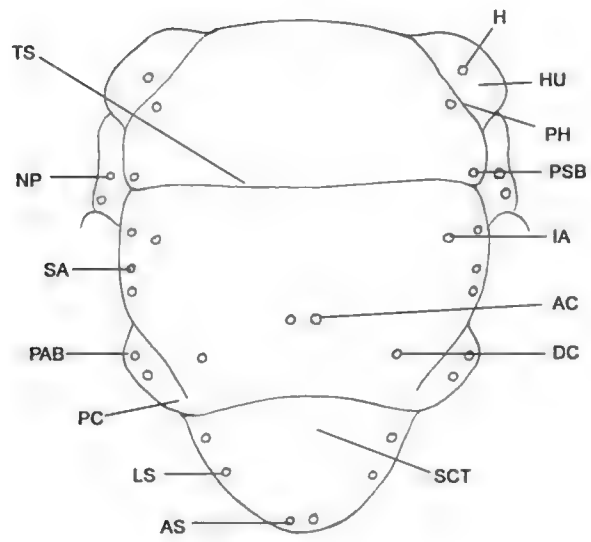

FIG 18

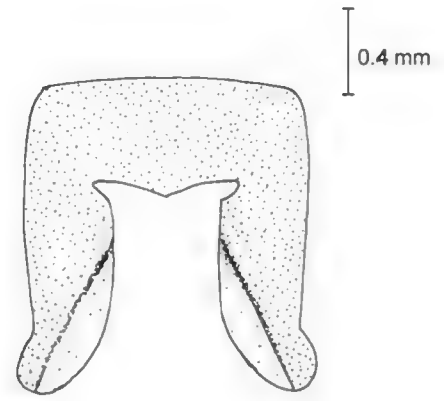

FIG 19

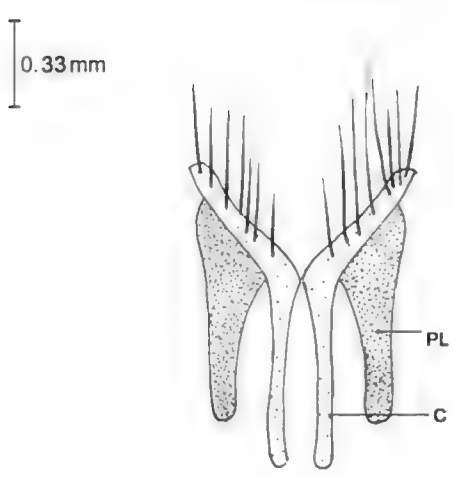

FIG 20

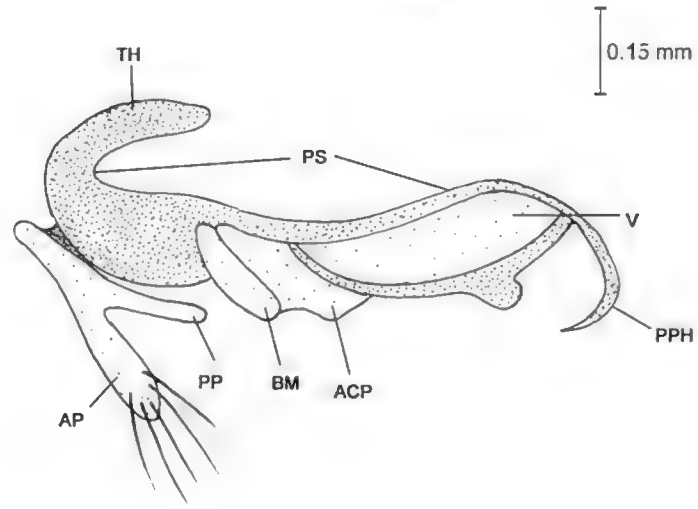

FIG 21

Figs. 15-21: *Stomorhina melastoma*: **15.** Dorsal view of ovipositor; **16**. Ventral view of ovipositor; **17.** Sternites I-V of female; **18.** Dorsal view of chaetotaxy of thorax (Diagrammatic); **19.** Sternite V of male; **20.** Cerci and paralobi; **21.** Aedeagus and parameres

black with black and pale hair; antennae light brownish; 2nd segment with one long bristle; length of 3rd segment about 3.5X that of 2nd; arista light brown, long, plumose on dorsal side only; palpi brown with bristles present all over.

Thorax: Metallic green with light golden tomentum; humerus and postalar callus concolorous with dorsum; prothoracic spiracle yellow; propleuron bare with golden dusting; prosternum hairy; postalar declivity bare; supraspiracular convexity bare; suprasquamal ridge bare.

Chaetotaxy (Fig. 18): Acrostichals 0+1; dorsocentrals 0+1; intra-alar 0+1; presutural present; humeral 1; posthumeral 1; supra-alars 3; post-alars 2; notopleurals 2; lateroscutellars 2; apicoscutellar 1; discoscutellar absent; sternopleurals 1+1; propleural present; prostigmatic absent.

Wings: Hyaline, slightly infuscated at base and apex; veins brown; stem vein (R) setulose; R1 bare; R4+5 setulose near base on both dorsal and ventral sides; first posterior cell (R5) open; epaulet and basicosta black; subcostal sclerite brown with fine pubescence; alar and thoracic squamae smoky yellow with yellowish marginal cilia, bare on dorsal surface; halteres brown.

Legs: Femora black with purplish tinge; tibiae and tarsi yellowish; tips of tarsi darkened; fore- and hind femora with bristles present on both dorsal and ventral sides while midfemur with bristles on ventral side only; fore- and mid tibiae each with 2 bristles each at middle and apex; hindtibia with 1 bristle at middle and 2 at apex.

Abdomen: Purplish with coppery reflections; tergites 2-3 with dark posterior band and weak marginal bristles; tergites 4 and 5 with strong marginal bristles; sternites 1-5 with golden hair; hypopygium conspicuous.

Male genitalia: Fifth sternite (Fig. 19), Cerci and paralobi (Fig. 20), Aedeagus and parameres (Fig. 21).

FEMALE: Body length 8.5 - 9.0 mm.
Similar to the male except : eyes dichoptic, frons wider and parallel sided, fronto-orbital bristles present, tergites 2-3 with strong marginal bristles. Sternites 1-5 (Fig. 17).

Female genitalia: Dorsal view of ovipositor (Fig. 15), Ventral view of ovipositor (Fig. 16).

Material examined: Himachal Pradesh: Manali-2050m (11♂♂, 3♀♀) 9.ix.2000; Coll. Inderpal Singh Sidhu.

Distribution: India (Himachal Pradesh, Tamil Nadu, Kerala, West Bengal), Indonesia, Nepal, Sri Lanka, China, Australia and New Guinea.

Holotype depository: ZSI, Calcutta, India.

Remarks: This species is distributed in the Oriental and Australian regions. There has been lot of shifts in the generic and specific combination as is depicted in the given synonymy. Adults have been collected from flowers and nothing is known about the bionomics of this species.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 48-61, 2019
doi: 10.5281/zenodo.3593793

New distributional records of fairyflies (Hymenoptera: Chalcidoidea: Mymaridae) from rice–agroecosystems of Kerala

K.M. Rajesh[1], Shahid Bin Zeya[2], A.P. Ranjith[1] & *M. Nasser[1]

[1]*Insect Ecology and Ethology Laboratory, Department of Zoology, University of Calicut, Kerala, India.*
[2]*Department of Zoology, Aligarh Muslim University, Uttar Pradesh, India.*

(Email: drnasher@gmail.com)

Abstract

***Gonatocerus aegyptiacus* Soyka, 1950, *Gonatocerus shamimi* Subba Rao and Hayat, 1986 (Hymenoptera: Chalcidoidea: Mymaridae), *Anagrus* sp. are recorded from Kerala for the first time. Ten species of Mymarids are new distributional records from the rice-agroecosystems of Kerala. The samples were taken from the rice fields of Kerala using sweep net method during July 2013 - February 2015, and the collection comprises mymarids belonging to 10 species under 5 genera.**

Keywords: *Mymaridae, New distribution, Rice-Agroecosystems, Kerala.*

Received: 7 November 2018; Revised: 31 December 2019; Online: 31 December 2019

Introduction

The family Mymaridae (Hymenoptera: Chalcidoidea) is one of the most distinctive families of Chalcidoidea and includes the smallest known insects and are all parasitoids of eggs laid in concealed habitats (Huber *et al.*, 2009). The members are widely distributed with 117 genera known from two subfamilies, Gonatocerinae and Mymarinae (Noyes and Valentine, 1989). Majority of them attack Auchenorrhyncha hemipteran, but Coleoptera, Psocoptera, Diptera and Orthoptera are also attacked (Huber and Rajakulendran, 1988). Members can be identified by using a combination of characters; female antennae with distinct club, head with 'H' shaped mark, protibial spur often long and curved, tarsi with 4–5 tarsomeres and metasoma either broadly or narrowly attached with mesosoma.

Systematic and biological research on the Mymaridae up until 1984 has been reviewed by Huber and Rajakulendran (1988). The major taxonomic treatises on the group are those of Debauche (1948), and Peck (1963). Further studies which should be of interest are those of Enock (1909), Girault (1911, 1912), Soyka (1950), Hincks (1960), Sahad and Hirashima (1984) and Matthews (1986).

To date 194 species under 38 genera are reported from India (Manickavasagam and Athithya, 2018). Taxonomic studies on Indian mymarids were mainly carried out by Verma (1980), Subba Rao and Hayat (1983), Hayat (1992), Zeya and Hayat (1995), Hayat and Anis (1999 a,b,c), Hayat and Singh (2001), Hayat *et al.* (2008), Rehmat *et al.* (2009), Zeya and Khan (2011), Rameshkumar *et al.* (2011 a,b) Manickavasagam and Rameshkumar (2011, 2012), and Manickavasagam *et al.* (2011). As per Noyes (2019) only 35 species in 14 genera were reported from Kerala.

The species like other chalcid families (Eulophidae, Trichogrammatidae) are most encountered parasitoids of pest species and have potential as biological control agents against different pests belonging to Cicadellidae, Miridae, Membracidae and Chrysomelidae in different crops or in their natural environment (Noyes, 2003). These parasitoids attack eggs of insects in a variety of habitats and crops, but its efficacy appears to vary with host plant species (Graham *et al.*, 1986). Little is known about the host parasitoid association as only about one

quarter of the genera have hosts reported for them.

Studies by Forster (1847), Enock (1909), Macgill (1934), Doutt (1959), Anderson & Paschke (1968), Stoner and Surber (1969), Miura (1979), Sahad (1982), Graham *et al.* (1986), Huber and Rajakulendran (1988), Norton *et al.* (1992), Conti *et al.* (1996), De Moraes and Mescher (1999), Virla (2001) and Jones (2001) reveals the importance of mymarids as parasitoids of insect pests.

In this paper, we reviewed the distribution and abundance of mymarid genera and species in rice agro-ecosystems of Kerala, south India.

Materials and Methods

The survey of mymarid parasitoids of rice fields was carried out from July 2013 to February 2015 during the Kharif (July—November) and Rabi (December—March) seasons. The samples were taken from the rice fields of 10 districts (three plots per district) by sweep net method.

Sweeping was done 25 meter along the bunds of rice field and two meter inside from edges, swept once at each step in a figure of eight. The trapped insects were collected using an aspirator and transferred to labeled bottles containing 70% ethyl alcohol. The collected specimens were dried and card mounted. Hexamethyldisilazane (HMDS) was employed as the drying agent during mounting in order to avoid collapsing. Images of identified parasitoids were taken using Leica M205 A with DMC 2900 camera. Multiple images with different focal levels were combined into a single image using Leica Automontage Software V4.7. Images were edited in Adobe Photoshop to remove artifacts formed during stack processing. Distribution map was made with ArcGis software version 9.3 (ArcGIS 9.3 Improves Your Entire GIS Workflow: Enhanced Data Management, New Cartographic Tools, and More Efficient Information Sharing". *ESRI. 2008-06-25. Archived from* the original *on 2008-06-30.*).

Results

The aim of the present investigation is to study the species composition of Mymaridae distributed in the rice–agro systems of Kerala. From the present survey 10 species of mymarids in five genera were collected, in which, *G. aegyptiacus G. shamimi* and *Anagrus* sp. are new distributional report from Kerala. Of the ten species of mymarids collected during the present study, eight of them with the exception of *Lymaenon* species are new distributional records from rice fields of Kerala.

New distributional reports of Mymarid fauna of Rice-Agrosystems from Kerala (Fig. 1)

1. *Gonatocerus aegyptiacus* Soyka, 1950 (Fig. 3B)

Specimen examined: INDIA: Kerala, Thrissur, Mullakkara, 22.iii.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Alappuzha, Kainakari, 5.ii.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Wayanad, Kambalakkad, 8.xi.2012, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Wayanad, Kambalakkad, 6.xii.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Kannur, Nellikkapalam, 28.xi.2013, sweep net coll. Rajesh, K.M.; INDIA: Kerala, Kannur, Maniyoor, 7.ii.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Ernakulam, Thuruthikkara, 26.i.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Ernakulam, Thuruthikkara, 7.iii.2014, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Kozhikode, Mundoth, 10.x.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Malappuram, Kalachal, 22.iii.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Thiruvananthapuram, Amaravila, 23.i.2013, sweep net, coll. Ranjith, A.P.

Distribution: India: Assam (Zeya and Hayat, 1995), Andhra Pradesh (Zeya and Hayat, 1995), Bihar (Zeya and Hayat, 1995), Jammu & Kashmir (Zeya and Hayat, 1995), Karnataka (Zeya and Hayat, 1995), Meghalaya (Zeya and Hayat, 1995), Tamil Nadu (Zeya and Hayat, 1995), Delhi (Anwar and Zeya, 2012), Himachal Pradesh (Anwar and Zeya, 2012), Odisha (Anwar and Zeya, 2012), Puducherry (Anwar and Zeya, 2012), Punjab (Anwar and Zeya, 2012), Uttarakhand (Anwar and Zeya, 2012), West Bengal (Anwar and Zeya, 2012), Andaman and Nicobar (Zeya *et al.*, 2014), Uttar Pradesh (Shamim and Shafee, 1984; Subba Rao and Hayat, 1986) and Kerala (Present study).

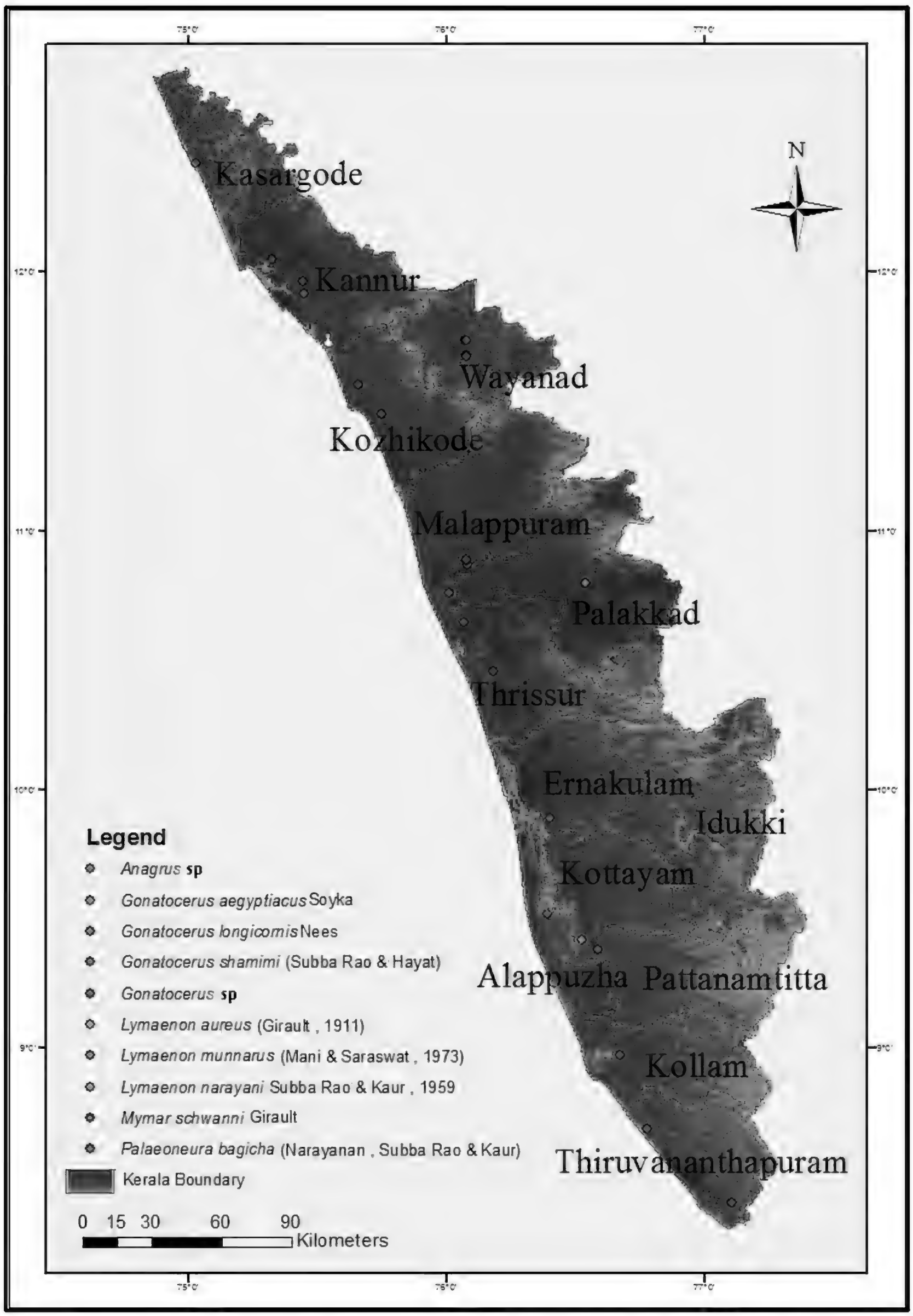


Figure 1: Distribution map of Mymaridae in Rice Agro-ecosystems of Kerala

Plant associates: Poaceae: *Oryza sativa* L. (Present study).

2. *Gonatocerus shamimi* Subba Rao and Hayat, 1986 (Fig. 3D)

Specimens examined: INDIA: Kerala, Palakkad, Thenur, 27.viii.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Kozhikode, Mundoth, 10.x.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Thiruvananthapuram, Amaravila, 23.1.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Kannur, Kaively, 29.xi.2013, sweep net, coll. Rajesh, K.M.

Distribution: India: Bihar (Manickavasagam and Rameshkumar, 2011), Meghalaya (Zeya, 2015), Odisha (Zeya, 2015), Tamil Nadu (Manickavasagam and Rameshkumar, 2011) Uttar Pradesh (Shamim and Shafee, 1984), Andhra Pradesh (Rameshkumar and Manickavasagam, 2014), Jharkhand (Anwar and Zeya, 2012), West Bengal (Anwar and Zeya, 2012) and Kerala (Present study).

Plant associates: Poaceae: *Oryza sativa* L. (Present study).

3. *Lymaenon aureus* (Girault, 1911) (Fig. 3F)

Specimen examined: INDIA: Kerala, Kottayam, Changanassery, 25.1.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Kannur, Nellikkapalam, 28.xi.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Palakkad, Thenur 27.xii.2013, sweep net, coll. Rajesh, K.M.

Distribution: India: Jammu & Kashmir (Narayanan, 1961), Maharashtra (Mani *et al.*, 1973), Uttar Pradesh (Shamim and Shafee, 1984) Andhra Pradesh (Amer *et al.*, 2017), Assam (Amer *et al.*, 2017), Bihar (Amer *et al.*, 2017), Himachal Pradesh (Amer *et al.*, 2017), Jharkhand (Amer *et al.*, 2017), Karnataka (Amer *et al.*, 2017), Kerala (Amer *et al.*, 2017), Odisha (Amer *et al.*, 2017), Puducherry (Amer *et al.*, 2017), Punjab (Amer *et al.*, 2017), Sikkim (Amer *et al.*, 2017), Uttarakhand (Amer *et al.*, 2017), West Bengal (Amer *et al.*, 2017), Tamil Nadu (Zeya and Hayat, 1995) and Meghalaya (Ramesh Kumar *et al.*, 2015).

Plant associates: Fabaceae: *Medicago sativa,* Poaceae: *Oryza sativa* L. (Present study).

4. *Lymaenon narayani* Subba Rao and Kaur, 1959

Specimen examined: INDIA: Kerala, Kannur, Nellikkapalam, 28.xi.2013, sweep net, coll. Rajesh, K.M.

Distribution: India: Uttar Pradesh (Subba Rao and Hayat, 1986), Kerala (Amer *et al.*, 2017), Andaman & Nicobar (Amer *et al.*, 2017), Andhra Pradesh (Amer *et al.*, 2017), Bihar (Amer *et al.*, 2017), Delhi (Amer *et al.*, 2017), Himachal Pradesh (Amer *et al.*, 2017), Karnataka (Amer *et al.*, 2017), Odisha (Amer *et al.*, 2017), Puducherry (Amer *et al.*, 2017), Tamil Nadu (Amer *et al.*, 2017), Uttarakhand (Amer *et al.*, 2017), and West Bengal (Amer *et al.*, 2017).

Plant associates: Poaceae: *Oryza sativa* L. (Present study).

5. *Gonatocerus longicornis* Nees, 1834 (Fig. 3C)

Specimen examined: INDIA: Kerala, Kollam, Kundara, 23.i.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Wayanad, Panamaram, 8.xi.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Wayanad, Kambalakkad, 6.xii.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Thiruvananthapuram, Amaravila, 23.i.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Ernakulam, Thuruthikkara, 7.iii.2014, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Kozhikode, Mundoth, 12.iv.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Thrissur, Ottappilavu, 12.v.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Kannur, Kaively, 29.xi.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Kannur, Kudukkimotta, 7.ii.2013, sweep net, coll. Ranjith, A.P.

Distribution: India: Kerala (Mani *et al.*, 1973), Karnataka (Subha Rao & Hayat, 1986), Tamil Nadu (Subha Rao & Hayat, 1986), Assam (Zeya and Hayat, 1995), Jammu & Kashmir (Zeya and Hayat, 1995), Madhya Pradesh (Zeya and Hayat, 1995), Odisha (Zeya and Hayat, 1995), Uttar Pradesh (Zeya and Hayat, 1995), Jharkhand (Anwar and Zeya, 2012), Uttarakhand (Anwar and Zeya, 2012), West Bengal (Anwar and Zeya, 2012) and Andaman & Nicobar (Zeya *et al*, 2014).

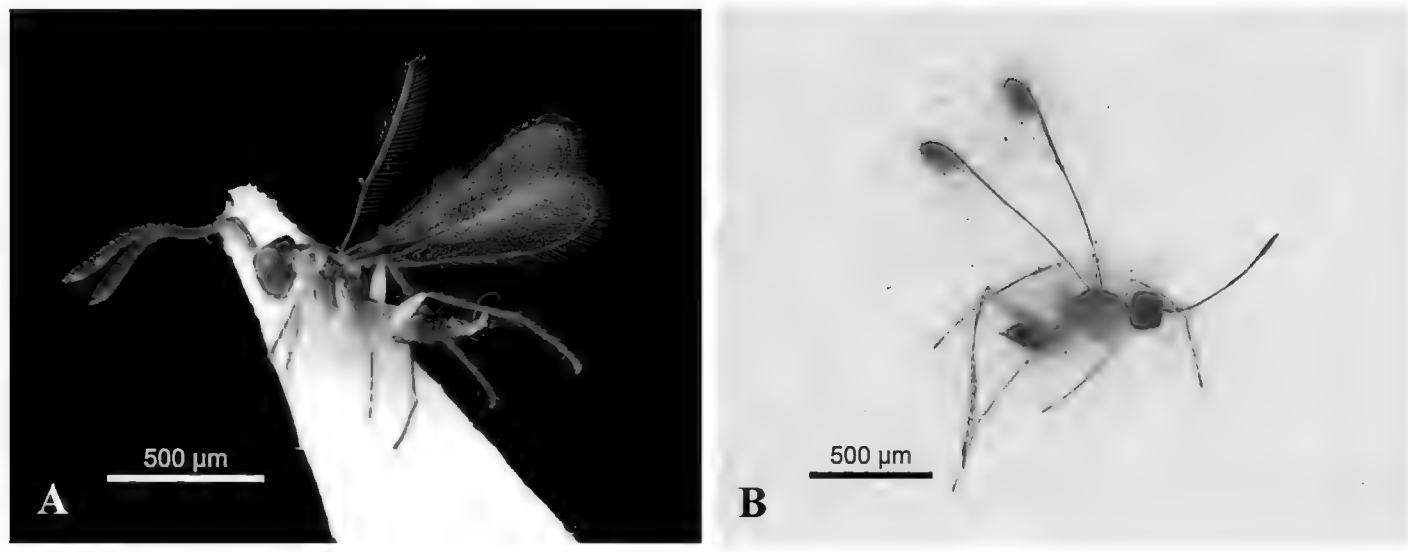
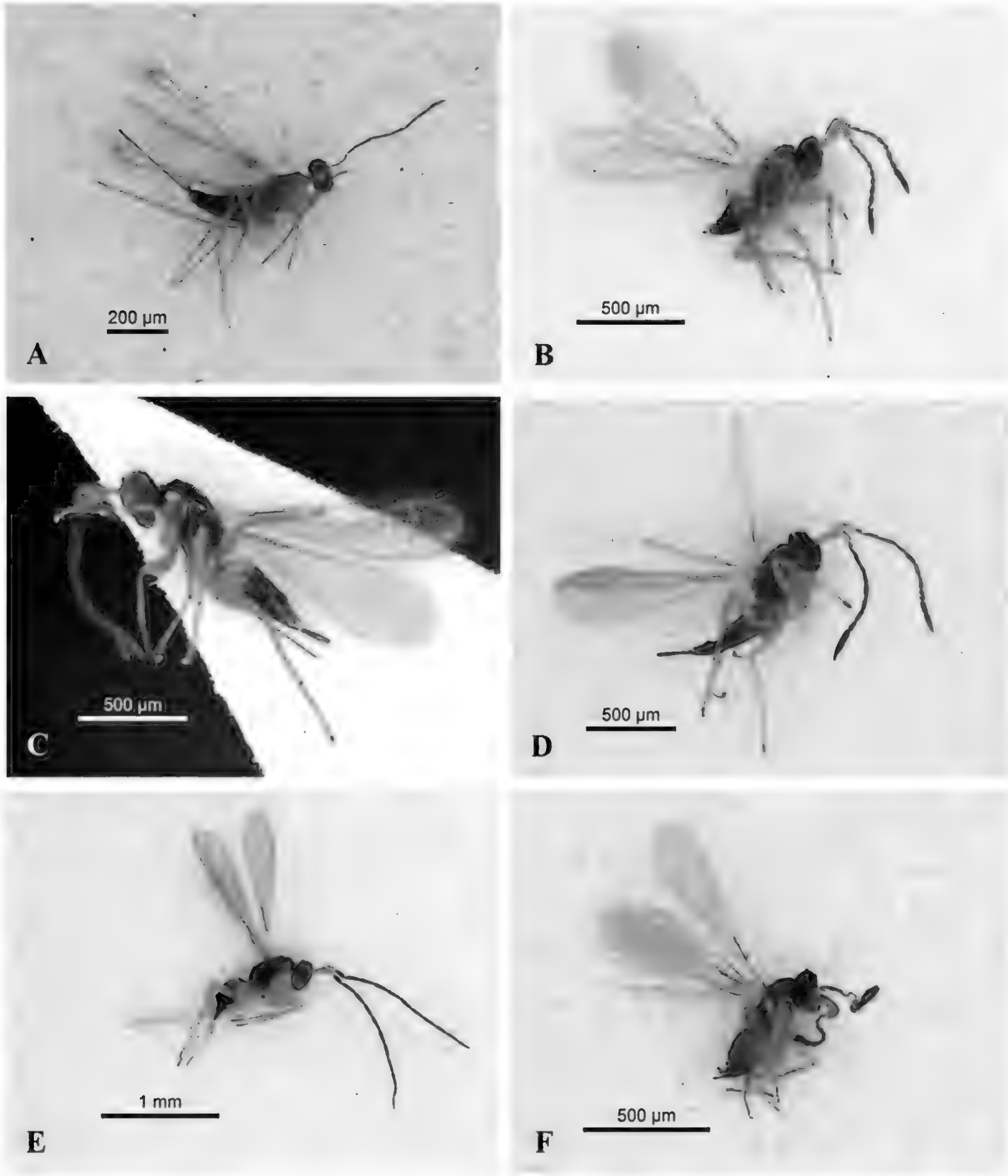


Figure 2: A. *Lymaenon munnarus* (Mani and Saraswat, 1973); **B.** *Mymar schwanni* Girault, 1912



Figures 3A-F: A. *Anagrus* sp.; **B**. *Gonatocerus aegyptiacus* Soyka, 1950; **C**. *Gonatocerus longicornis* Nees, 1834; **D**. *Gonatocerus shamimi* Subba Rao and Hayat, 1986; **E**. *Gonatocerus* sp.; **F**. *Lymaenon aureus* (Girault, 1911).

Plant associates: Betulaceae: *Corylus avellana* (Viggiani, 1974), Fabaceae: *Medicago sativa* (Pricop, 2009), Poaceae: *Oryza sativa* L. (Present study).

6. *Lymaenon munnarus* (Mani and Saraswat, 1973) (Fig. 2A)

Specimen examined: INDIA: Kerala, Pathanamthitta, Thiruvalla, 24.i.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Thiruvananthapuram, Kadakkavoor, 23.i.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Palakkad, Thenur, 27.viii.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Wayanad, Kambalakkad, 6.xii.2013, sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Thrissur, Ottapilavu, 12.v.2013, sweep net, coll. Ranjith, A.P.

Distribution: India: Andhra Pradesh (Manickavasagam *et al*., 2011), Jammu & Kashmir (Manickavasagam *et al*., 2011; Amer *et al*., 2017), Karnataka (Manickavasagam *et al*.,2011), Kerala (Manickavasagam *et al*., 2011), Madhya Pradesh (Manickavasagam *et al*., 2011), Maharashtra (Manickavasagam *et al*., 2011), Tamil Nadu (Manickavasagam *et al*., 2011), Uttar Pradesh (Manickavasagam *et al*., 2011), Himachal Pradesh (Amer *et al*., 2017), Jharkhand (Amer *et al*., 2017), Odisha (Amer *et al*., 2017) and West Bengal (Amer *et al*., 2017).

Plant associates: *Oryza sativa* L. (Present study).

7. *Mymar schwanni* Girault, 1912 (Fig. 2B)

Specimens examined: INDIA: Kerala, Alappuzha, Kainakari, 5.ii.2013 sweep net, coll. Ranjith, A.P.; INDIA: Kerala, Ernakulam, Thuruthikkara, 7.iii.2014, sweep net, coll. Ranjith, A.P.

Distribution: India: Andhra Pradesh (Manickavasagam *et al*., 2011), Karnataka (Manickavasagam *et al*., 2011), Kerala (Manickavasagam *et al*., 2011), Odisha (Manickavasagam *et al*., 2011), Tamil Nadu (Manickavasagam *et al*., 2011), Uttar Pradesh (Manickavasagam *et al*., 2011), Uttarakhand (Manickavasagam and Rameshkumar, 2011) and Puducherry (Manickavasagam *et al*., 2011).

Plant associates: Poaceae: *Oryza sativa* L. (Present study).

8. *Palaeoneura bagicha* (Narayanan, Subba Rao and Kaur, 1960)

Specimens examined: INDIA: Kerala, Kannur, Kaiveli, 29.xi.2013, sweep net, coll. Rajesh, K.M.

Distribution: Delhi (Huber, 2003), Himachal Pradesh (Manickavasagam *et al*., 2011), Kerala (Manickavasagam *et al*., 2011), Maharashtra (Subha Rao and Hayat, 1986), Punjab (Manickavasagam *et al*., 2011), Tamil Nadu (Manickavasagam *et al*., 2011), Uttar Pradesh (Hayat, 1992) Karnataka (Subha Rao, 1989), Meghalaya (Rameshkumar *et al*., 2015), Uttarakhand (Joshi *et al*., 2017) and Arunachal Pradesh (Amer and Zeya, 2018)..

Primary hosts: Hemiptera: Cicadelidae: *Sophonia rufofasciata* (Yang *et al*., 2002).

Plant associates: Poaceae: *Oryza sativa* L. (Present study).

9. *Anagrus* sp. (Fig. 3A)

Specimens examined: INDIA: Kerala, Kannur, Nellikkapalam, 28.xi.2013, sweep net, coll. Rajesh, K.M.

10. *Gonatocerus* sp. (Fig. 3E)

Specimens examined: INDIA: Kerala, Kannur, Nellikkapalam, 28.xi.2013, sweep net, coll. Rajesh, K.M.; INDIA: Kerala, Alappuzha, Kainakari, 5.ii.2013, sweep net, coll. Ranjith, A.P.

Gonatocerus aegyptiacus is the numerically abundant mymarid species collected and distributed in nine districts viz: Kannur, Kozhikode, Wayanad, Malappuram, Palakkad, Thrissur, Ernakulam, Alappuzha and Thiruvananthapuram. *Gonatocerus longicornis* is the second dominant species recorded in 10 districts except Kottayam, Idukki, Pathanamthitta and Palakkad. Mymarid species richness in Kannur district was the highest with eight species viz: (*G. aegyptiacus, G. shamimi, G. longicornis, Lymaenon aureus, L. narayani*, *Palaeoneura bagicha* and *Gonatocerus* sp.),

Table 1. The distribution of Mymaridae in Rice-Agroecosystems of Kerala

SI. No	Species	Place
1.	*Gonatocerus longicornis* Nees, 1834	Kollam – Kundara : 8°58'05.6"N 76°40'24.3"E Malappuram – Valanchery : 10°53'08.4"N 76°04'41.4"E Ernakulam – Thuruthikkara : 9°53'17.0"N 76°24'13.1"E Panamaram–Wayanad : 11°44'09.7"N 76°04'38.4"E Wayanad – Kambalakkadu : 11°40'31.1"N 76°04'39.3"E Thiruvananthapuram – Amaravila : 8°23'50.0"N 77°06'26.1"E Thiruvananthapuram –Kadakkavoor : 8°41'02.1"N 76°46'43.8"E Ernakulam – Thuruthikkara : 9°53'17.0"N 76°24'13.1"E Thrissur– Ottapilavu : 10°38'36.0"N 76°04'13.5"E Kozhikode – Mundoth : 11°27'04.4"N 75°45'08.9"E Kannur – Kaiveli : 12°03'00.1"N 75°19'38.5"E Alappuzha – Kainakari : 9°30'58.5"N 76°23'31.8"E Kannur – Kudukkimotta : 11°54'57.0"N 75°26'55.8"E Kasaragode – Pallikkara : 12°25'17.7"N 75°01'57.3"E

2.	*Gonatocerus aegyptiacus* Soyka, 1950	Thrissur– Mullakkara : 10°27'07.9"N 76°10'57.3"E Palakkad – Thenur : 10°47'42.5"N 76°32'26.7"E Ernakulam – Thuruthikkara : 9°53'17.0"N 76°24'13.1"E Kozhikode – Mundoth : 11°27'04.4"N 75°45'08.9"E Wayanad – Kambalakkad : 11°40'31.1"N 76°04'39.3"E Kannur – Nellikkapalam : 11°57'41.6"N 75°26'40.9"E Alappuzha – Kainakari : 9°30'58.5"N 76°23'31.8"E Thiruvananthapuram – Amaravila : 8°23'50.0"N 77°06'26.1"E Malappuram – Kalachal : 10°45'30.4"N 76°00'57.7"E Kannur – Maniyoor : 11°33'50.6"N 75°39'36.2"E Malappuram – Valanchery : 10°53'08.4"N 76°04'41.4"E
3.	*Gonatocerus shamimi* Subba Rao and Hayat, 1986	Malappuram – Valanchery : 10°53'08.4"N 76°04'41.4"E Palakkad – Thenur : 10°47'42.5"N 76°32'26.7"E Kozhikode – Mundoth : 11°27'04.4"N 75°45'08.9"E Thiruvananthapuram – Amaravila : 8°23'50.0"N 77°06'26.1"E Kannur – Kaiveli : 12°03'00.1"N 75°19'38.5"E
4.	*Lymaenon munnarus* (Mani and Saraswat, 1973)	Pathanamthitta – Thiruvalla : 9°22'43.9"N 76°35'18.6"E Thiruvananthapuram – Kadakkavoor : 8°41'02.1"N 76°46'43.8"E

		Palakkad – Thenur : 10°47'42.5"N 76°32'26.7"E Wayanad – Kambalakkadu : 11°40'31.1"N 76°04'39.3"E Malappuram – Valanchery : 10°53'08.4"N 76°04'41.4"E Thirissur – Ottapilavu : 10°38'36.0"N 76°04'13.5"E Ernakulam – Thuruthikkara : 9°53'17.0"N 76°24'13.1"E
5.	*Lymaenon aureus* (Girault, 1911)	Kottayam – Changanassery : 9°25'03.0"N 76°31'26.9"E Palakkad – Thenur : 10°47'42.5"N 76°32'26.7"E Kannur – Nellikkapalam : 11°57'41.6"N 75°26'40.9"E
6.	*Lymaenon narayani* Subba Rao and Kaur, 1959	Kannur – Nellikkapalam : 11°57'41.6"N 75°26'40.9"E
7.	*Palaeoneura bagicha* (Narayanan, Subba Rao and Kaur, 1960)	Kannur– Kaiveli : 12°03'00.1"N 75°19'38.5"E
8.	*Mymar schwanni* Girault, 1912	Alappuzha – Kainakari : 9°30'58.5"N 76°23'31.8"E Ernakulam – Thuruthikkara : 9°53'17.0"N 76°24'13.1"E
9.	*Gonatocerus* sp.	Kannur – Nellikkapalam : 11°57'41.6"N 75°26'40.9"E Alappuzha – Kainakari : 9°30'58.5"N 76°23'31.8"E
10.	*Anagrus* sp.	Kannur – Nellikkapalam : 11°57'41.6"N 75°26'40.9"E

followed by Alappuzha (*G. longicornis, G. aegyptiacus, Mymar schwanni, Anagrus* sp. and *Gonatocerus* sp.), species richness is least in Kottayam (*L. aureus* only) and Kollam (*G. longicornis* only) districts (Table 1).

Discussion

Out of the 1424 species reported from 103 genera worlwide, only 194 species under 38 genera are known from the Indian subcontinent that constitute 32.8 and 11.9 per cent of world genera and species respectively (Manickavasagam and Athithya, 2018). Manickavasagam and Athithya in 2018 constructed the very latest checklist of Indian mymarids, with five genera *viz*., *Allanagrus*, *Dorya*, *Platystethynium*, *Schizophragma* and *Stephanocampta* were newly recorded, four genera *viz*., *Cosmocomoidea, Lymaenon, Tanyxiphium* and *Zeyanus* were added during reclassification of *Gonatocerus*, 56 new species were described and 12 first reports of species were made from India. Seven species *viz*., *Acmopolynema shrawastianum*, *Erythmelus lygivorus*, *Gonatocerus sulphuripes*, *G. tarae*, *G. pahlgamensis*, *G. similis* and *Polynema huberi* were synonymized and one species misidentified.

Distribution status of the Mymaridae from Kerala is comparatively wider as 35 species under 14 genera were recorded earlier. Most of the mymarids were reported as solitary/ gregarious egg parasitoids of the plant/leaf hoppers (Huber and Rajakulendran, 1988). Present study extended the distribution status of mymarids in the rice agroecosystems with the first report of species *G. aegyptiacus* from south India. The distribution of *G. aegyptiacus* is found to be very wide as it extended from Holarctic to the Oriental regions (Soyka, 1950; Sahad, 1982; Sahad and Hirashima, 1984; Subba Rao and Hayat, 1986; Donev, 2003).

The present study also portraits the distribution and abundance of fairyflies in the rice fields as ten species under five genera were reported exclusively from rice fields of Kerala.

Among the studied species, the speciose genus, *Gonatocerus* is numerically abundant with 26 specimens from four species. This result is well in line with the study of Rameshkumar *et al*. (2011b) as 13 species were already recorded from the Kerala state. In addition to this the distribution of the species listed in the present study apparently confirms the biological association of the genus with the rice agroecosystems as the species *G. longicornis* and *G. shamimi* were already recorded from rice paddy ecosystems. Most of the *Gonatocerus* species are already reported from north Indian states but the extended distribution of *Gonatocerus* (*G. ater* Foerster, 1841, *G. bakrotus* Mani and Saraswat, 1973, *G. bashai* Zeya, 1995, *G. bouceki* Zeya, 1995, *G. delhiensis* (Narayanan and Subba Rao, 1961) and *G. shamimi*) indicates that the genus has a wider distribution status within the Indian subcontinent than reported earlier (Zeya and Hayat, 1995; Rameshkumar *et al*., 2011a,b).

Despite the wide distribution of Indian *Gonatocerus,* some species are found to be endemic to south India like *G. berijamus* Mani and Saraswat, 1973 and *G. kodaianus* (Mani and Saraswat, 1973) (Rameshkumar *et al*., 2011a, b). Similarly all the *Lymaenon* species collected during the present study were already recorded from the rice paddy ecosystems (Rameshkumar *et al*., 2011b).

In 2017, Amer *et al.* conducted a survey on Indian mymarids, and they provided many new distribution reports from all over India.

As mentioned in the results the 10 species recorded in the present study from rice ecosystems of Kerala are distributed across many states of India. This study has recorded additional mymarid species as possible parasitoids of pests of rice. In addition to this *L. narayani* earlier recorded as a parasitoid of *Eucoccosterphus tuberculatus* (Hemiptera: Membracidae) (Zeya and Hayat, 1995) has now been collected from rice fields which opens up the possibility of an alternate host for the parasitoid species as membracids are usually not seen in rice fields. Additionally, more detailed survey with emphasis on host rearing will help in providing the host association of mymarids which will help to facilitate the adoption and designing of biocontrol strategies to control pests of rice using mymarids.

Acknowledgements

This work was financially supported by Ministry of Environment, Forests and Climate

Change, New Delhi. We would like to express thanks to Dr. Santhosh S., Assistant Professor, Malabar Christian College, Kozhikode for providing facilities during photographic session. We also thankful to Mrs. Bindu, Assistant Professor in Geography, H.M. College of Science and Technology, Manjeri for her valuable help during the preparation of distribution map.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 62-74, 2019
doi: 10.5281/zenodo.3594368

Review of Sarcophagidae (Diptera) of North African countries with new faunistic data from Algeria

Yuriy Verves

Department of Ecological Monitoring, Institute for Evolutionary Ecology, National Academy of Sciences of Ukraine, Kyiv, Ukraine, Academician Lebedev Str. 37, Kyiv, Ukraine, 03143.

(Email: yuryverves@gmail.com)

Abstract

A total of 199 sarcophagid species are listed from North African region, including Algeria (84 species), Azores (17), Canary Is. (33), Ceuta & Melilla (2), Egypt (116), Libya (24, Madeira Is. (7), Malta (43), Morocco (49), and Tunisia (45). 20 species have been collected in Oum El Bouaghi forest, including one species new for science (*Sarcophila khrokaloe* sp. n.) and 10 species first recorded from Algeria (*Metopia argyrocephala*, *Paragusia multipunctata*, *Phrosinella fedtshenkoi*, *Helicophagella novercoides*, *Artamonoviella monspellensia*, *Heteronychia uncicurva*, *Thyrsocnema belgiana*, *Liosarcophaga catalunya*, *L. portschinskyi*, *L. teretirostris*).

Keywords: *Sarcophagidae, North Africa, Algeria, fauna, new species.*

Received: 5 July 2019; Revised: 19 November 2019; Online: 31 December 2019

Introduction

Altogether (including present data) 199 sarcophagid species (Enderlein (1928), Lehrer (1995, 2003a), Pape (1996); Povolný, 1992; Rohdendorf (1930, 1935, 1937, 1971, 1975), Salem (1938a, b), Séguy (1941a, b), Sotiraki *et al.* (2010), Verves (1982, 1985, 1986, 1993a, b), Verves & Khrokalo (2006, 2015, 2017), Verves *et al.* (2015), Villeneuve (1910, 1912a, b), Whitmore (2011) have been recorded from the North African territory. Country faunas from within this region have been explored by many authors, the most significant ones being: Egypt (Abd El-Halim *et al.*, 2005, 2009; Becker, 1902, 1903; El-Ahmady *et al.*, 2015; El-Hawagry & El-Azab, 2019; Helal *et al.*, 1981; Lehrer 2003a; Mohamed & Abdel-Rahman, 1985; Rohdendorf, 1934; Salem, 1935, 1936, 1940; Salwa & Abdel-Rahman, 1983; Shaumar & Kamal, 1984; Steyskal & El-Bialy, 1967; Tantawi *et al.*, 1996, 2018); Libya (Séguy, 1935; Venturi, 1960); Malta (Gatt & Ebejer, 2014; Schembri *et al.*, 1991; Venturi, 1960; Villeneuve, 1910; Wyatt, 1991), Tunisia (Bezzi, 1922; Gatt & Ebejer, 2014; Mathis, 1957; Séguy, 1934), Spanish North Africa (Peris *et al.*, 1996), Morocco (Becker & Stein, 1914; Delanoë, 1922; El-Abrak *et al.*, 2002; El-Mezouari *et al.*, 2014; Farkas *et al.*, 2003; Lmimouni *et al.*, 2004; Romli *et al.*, 2010; Séguy, 1930, 1939, 1940a, b, 1941c, d, 1949, 1953; Tliqui *et al.*, 2007; Verves, 1993b), Canary Is. (Báez, 1980; Báez & Garcìa, 2004; Becker, 1908a; Carles-Tolrá, 2002, Lehrer & Báez, 1986; Peris *et al.*, 1996, 2001; Verves & Barták, 2017; Villeneuve, 1908), Madeira Is. (Becker, 1908b; Pape, 1986, 1990), Azores (Séguy, 1936; Kehlmaier, 1998). A brief review of studies of Algerian sarcophagids with a checklist of 74 species was published in my previous article (Verves, 2017). To compile the existing data here I present a checklist of 84 species.

Materials and Methods

The commune of Oum El Bouaghi is located in the north-east of Algeria in the Constantine Highlands on area of 7638.13 km². This commune is located in the high Constantine plains, between the mountain regions. It bends from the north to the south where it passes from an altitude of 1635 m (Jebel sidiR'ghiss) in the North, to 808m (Garaa of Tarf) to the South. 57 specimens of sarcophagids have been collected in Oum El Bouaghi forest, 1210 m, 35.899, 7.129, pt., iv.2016, by Mr. N. Baba Aissa and were sent to me by Prof. Miroslav Barták (Czech University of Life Sciences, Praha) for study. Author follows classification of Verves (1986)

and Verves & Khrokalo (2006) in order of species in check list. The material was examined under Nikon SMZ 1500 stereozoom microscope.

Abbreviations of morphological features: *acr* - acrostichal seta; *ad* - anterodorsal seta; *ap* - apical seta; *bas* - basal seta; *d* - discal seta; *dc* - dorsocentral seta; *dm-cu* - discal medial cubital crossvein; f_2 - mid femur; *fr* - frontal seta; *h* - humeral seta; *ia* - intraalar seta; *ivt* - inner vertical seta; *kepst* - katepisternal seta; *M* - medial vein; *npl* - notopleural seta; *oc* - ocellar seta; *orb* - orbital seta; *ovt* - outer vertical seta; *ph* - posthumeral seta; *poc* - postocellar seta; *pocl* - postorbital seta; R_1 - first longitudinal vein; R_{2+3} - second longitudinal vein; R_{4+5} - third longitudinal vein; r_5 - first posterior cell; *subap* - subapical seta; t_1 - fore tibia.

I provide here a checklist of Sarcophagidae for all the North African countries (Table 1).

Results

Description of a new species

***Sarcophila khrokaloe* Verves, sp. n.**

Figures: 1-2

urn:lsid:zoobank.org:act:40F60453-31A3-488C-A4AE-22258D720D30

Male. ***Head***: Black, thickly silver grey pollinated; antennae and palpi black. Eyes bare, dichoptic, separated at vertex 0.40×, at level of antennal base 0.36× of head width. Frontal vitta 1.67× widened backward, matt grey, with distinct grey-silver dusting around matt black ocellar triangle, about 2× as wide as one of parafrontalia just in front of anterior ocellus. Parafrontalia silver grey dusted, in addition to strong *orb* and *fr*, and with a longitudinal row of 4-6 small setae along the edge of the eye between the fore *orb* and fore *fr*. Two regular rows of *pocl* present; *fr* 6; *orb* 2+1; *oc* strong and long, directed laterodorsally; *poc* weak and elongate; *ovt* and *ivt* well developed. Parafacialia at level of antennal base 0.26× of head length, silver grey dusted, with a single irregular row of the mid-long fine black setae. Face distinctly widened forwardly to vibrissal angles, silver grey dusted, with broad facial carina. Facial ridge bare, vibrissae well developed. Genae 0.22× of head-height, thickly silver-grey dusted, clothed with numerous black setae. Genal groove blackish grey, bare. Postgenae black, largely clothed with mid-long black hairs. Occiput black, covered with black hairs. Pedicel matt black, its surface across pedicelar bristle orange yellow. First flagellomere matt black, about 1.8-2.0× as long as pedicel. Arista widened in basal 1/3, black, long plumose. Palpi entirely black, distinctly widened apically.

Thorax: Black, light grey-dusted, covered with black hairs. Dorsum marked with broad median, a pair of approximated narrow submedian and two lateral broad longitudinal black stripes on prescutum and scutum, each more distinctly visible when viewed from behind; only the median one reaches the end of scutellum. Humeri, notopleura, sternopleura and scutellum distinctly yellowish grey-dusted; thoracic spiracles yellowish white. Prosternum and propleuron bare, the other pleura with setae. *acr* 1+1; *dc* 2+3; *ia* 0+3; *h* 3; *ph* 1, *npl* 2, *kepst* 2+1. Scutellum with long strong pair of *ap* and more short fine *subap, bas* and *d*.

Wings: Membrane hyaline; veins yellowish brown; epaulet and basicosta yellowish white; subcostal sclerite yellowish brown. Costal spine small, unclear; R_1 and R_{2+3} bare; R_{4+5} with a row of black setae from basal node to the intersection with *r-m* above; node of R_{2+3} and R_{4+5} with a few black setae below. The ratio of 3rd and 5th costal sections is 1:1.4. Cell r_5 open; the last section of *M* curved at a blunt almost right angle; *dm-cu* sigmoid. Both calypteres white, slightly grayish, halteres yellow.

Legs: Black. Claws curved, distinctly shortened than 5th tarsomere; pulvilli ovale equal to claws in length; t_1 with 3 *ad*; f_2 without ctenidium.

Abdomen: Grey dusted, with shining black dorsal drawing. 1+2nd tergite with 3 (medial and two lateral) longitudinal bands; each of 3rd–5th tergites with 3 triangled hind spots. Middle longitudinal spots reach to the fore margins of 3rd and 4th tergites, and lateral spots oval, located in hind 0.5-0.6; 5th tergite with 3 rounded unclear spots in hind part.

Terminalia: Black, grey dusted. Narrowed apical part of cercus subulate, not serrated, shorter than widened basal one. Surstylus is separated by a deep oval cut on the upper and lower parts; the latter carries a vertical row of setae from the cut to the lower corner and numerous apical hairs (Fig. 1). Pregonites s-

like curved, pointed on apex; postgonites leaf-shaped in the apical part, with numerous hairs bearing particular dorsolateral site. Aedeagus with short apical hook and special membrane lobe located below. Hypophallus consists of a thickened hairy basal part and a narrow and long rod-shaped apical one located at an obtuse angle (Fig. 2).
Female: unknown.

Measurement: Holotype (male): Body length: 5.5 mm.

Etymology: The specific name is given in honour of my wife, well known Ukrainiaan entomologist Dr. Liudmyla A. Khrokalo (National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine).

Type material: Holotype ♂: Algeria, Oum El Bouaghi forest, 1210m, 35.899, 7.129, pt., iv.2016. Holotype is deposited in collection of Czech University of Life Sciences, Prague, Czech Republic.

Comparison: This species is related to *Sarcophila dayanella* Lehrer, 2003 (Fig. 3) from Syria and *Sarcophila navara* Lehrer, 2003 (Fig. 4) from Israel by a single row of black setae on parafacials, by shortened apical part of cercus and by strongly curved hypophallus, but differs by absence of spines of apical part of cercus, by presence of a vertical row of setae on lower part of surstylus, and pointed aedeagus.

Ecology: Probably, mesophilous forest species.

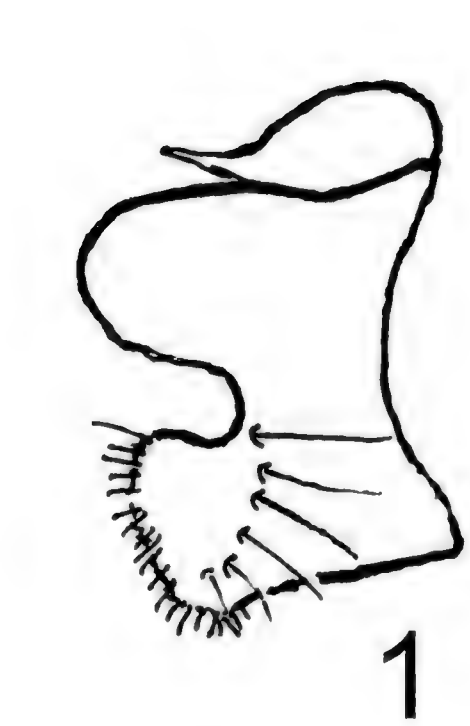
List of Algerian Sarcophagidae, collected in Oum El Bouaghi forest[1]

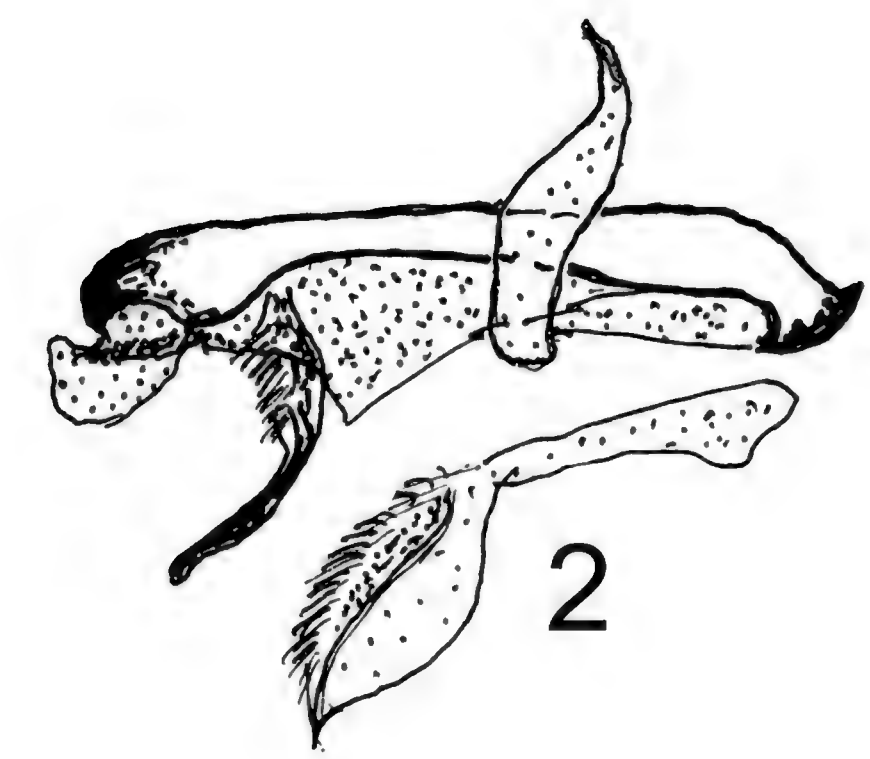
1. *Metopia* (s.str.) *argyrocephala* (Meigen, 1824)*[2]: 1 ♂.
2. *Paragusia multipunctata* (Rondani, 1859)*: 1 ♂.
3. *Phrosinella* (s. str.) *fedtshenkoi* (Rohdendorf, 1925)*: 1 ♂.
4. *Sarcophila khrokaloe* sp. n.*: 1 ♂.
5. *Blaesoxipha rufipes* (Macquart, 1839) [Verves, 1985, 2017][3]: 1 ♀.
6. *Helicophagella* (s. str.) *novercoides* Böttcher, 1913*: 3 ♂.
7. *Artamonoviella monspellensia* (Böttcher, 1913)*: 2 ♂.
8. *Heteronychia* (*Ctenodasypygia*) *minima* (Rondani, 1862) [Verves, 2017; Villeneuve, 1911; Whitmore, 2011): 9 ♂.
9. *H.* (*C.*) *thirionae* (Lehrer, 1976) [Verves, 2017; Whitmore, 2009]: 2 ♂.
10. *H.* (*C.*) *uncicurva* Pandellé, 1896*: 1 ♂, 1♀.
11. *H.* (*C.*) *villeneuveana* (Enderlein, 1928) [Enderlein, 1928]: 1 ♂.
12. *H.* (s. str.) *pandellei* (Rohdendorf, 1937) [Rohdendorf, 1937; Verves, 2017]: 3 ♂.
13. *Karovia hirticrus* (Pandellé, 1896) [Böttcher, 1912; Verves, 2017]: 6 ♂.
14. *Myorhina* (s. str.) *nigriventris* (Meigen, 1826) [Séguy, 1941; Verves, 2017]: 7 ♂, 1♀.
15. *Thyrsocnema belgiana* Lehrer, 1976*: 1 ♂.
16. *Bercaea africa* (Wiedemann, 1824) [James, 1947; Verves, 2017]: 3 ♂.
17. *Liosarcophaga* (s. str.) *catalunya* Lehrer, 2008*: 1 ♂
18. *L.* (s. str.) *marshalli* (Parker, 1923) [El-Hawagry & El-Azab, 2019]: 4 ♂.
19. *L.* (s. str.) *portschinskyi* (Rohdendorf, 1937)*: 1 ♂.
20. *L.* (s. str.) *teretirostris* (Pandellé, 1896)*: 8 ♂.

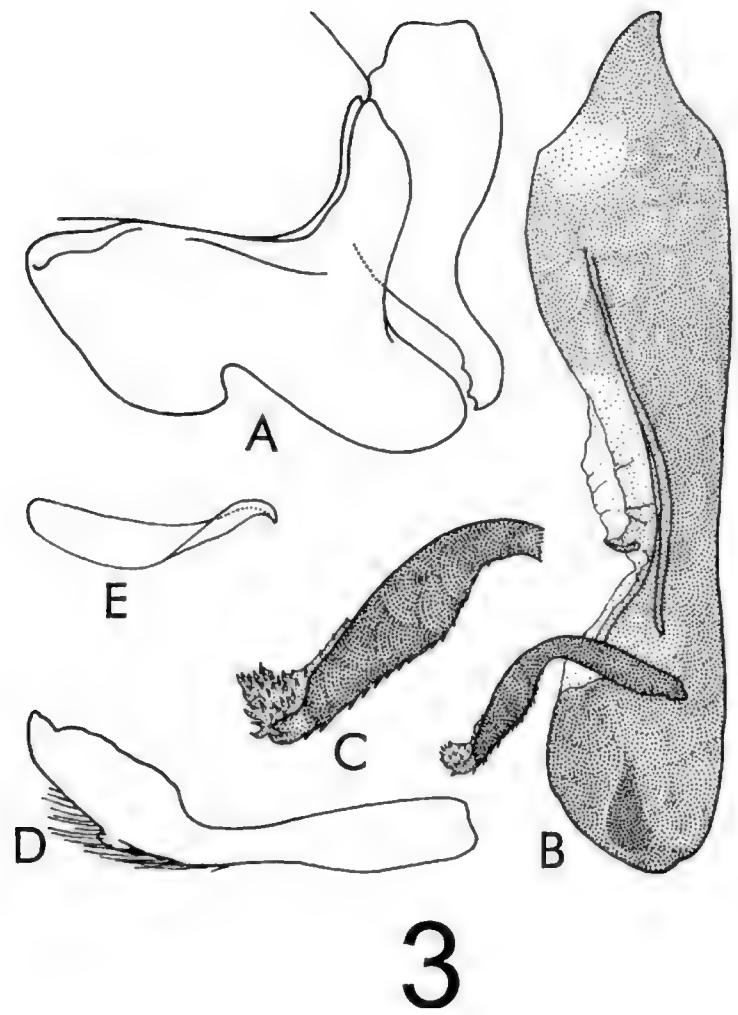
Discussion

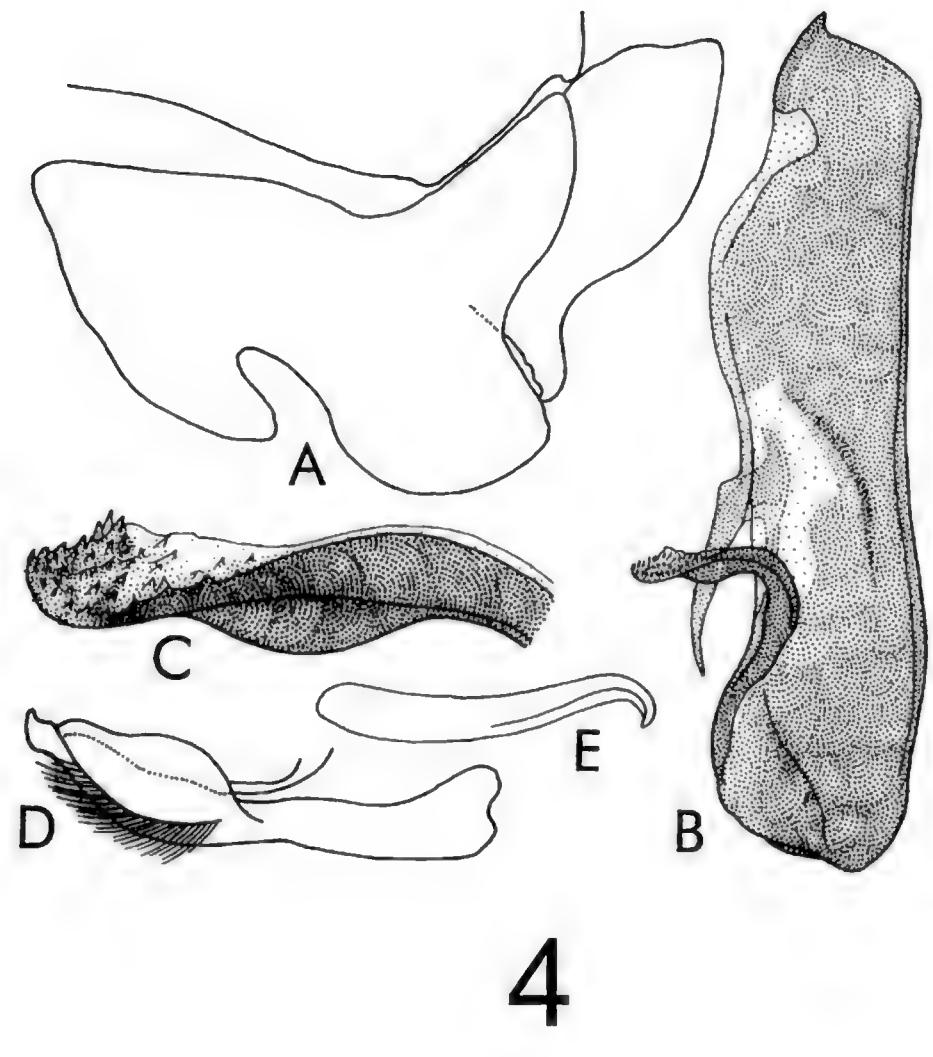
A total of 199 sarcophagid species are known from North African region. Regional faunas of North Africa are not studied in detail: their review (including the results of present paper) is given in Table 1. The regional cadastres present not less than 80-90% of full special lists of depleted island ecosystems, such as Azores (17 species), Canary Is. (33), Madeira (7) and Malta (45). Among continental countries, the most of the studies are designated for Egypt (116) and Algeria (84). The faunistic lists at level 20-40% are known for Morocco (49) Tunisia (45) and Libya (24). Only two species are known from the enclave area Ceuta & Melilla.

[1] The sequence of species in the list corresponds to the system of family adopted by Verves (1986).
[2] * - firstly recorded to Algerian fauna.
[3] The references to previous publications about the collection of this species in Algeria are given in square brackets.









Figures 1-4: Male genitalia (lateral view) of *Sarcophila khrokaloe* **sp. n.** [**1**. cercus and surstylus; **2**. aedeagus and gonites, orig.]; after Lehrer, 2003b: *S. dayaniella* Lehrer, 2003 [**3**] and *S. navara* Lehrer, 2003 [**4**]. A. cercus and surstylus; B. aedeagus; C. apical part of hypophallus; D. postgonite; E. pregonite.

Acknowledgements

Author is thankful to Prof., Dr. Sci. Miroslav Barták (Department of Zoology and Fisheries, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Prague, Czech Republic) for sending dry flies.

Table 1

List of species of Sarcophagidae from different North African countries[4]

No.	Species	Countries and islands (in direction from West to East)									
		Azores	Madeira Is.	Canary Is.	Morocco	Spanish Africa (Ceuta & Melilla)	Algeria	Tunisia	Malta	Libya	Egypt
1	*Macronychia* (s. str.) *lemariei* Jacentkovský, 1941	-	-	-	-	-	+	-	-	-	-
2	*M.* (*Moschusa*) *polyodon* (Meigen, 1824)	-	-	-	+	-	-	-	+	-	-
(2 sp.) Macronychiinae, sum		-	-	-	**1**	-	**1**	-	**1**	-	-
3	*Senotainia* (*Arrenopus*) *albifrons* (Rondani, 1859)	-	-	+	-	-	+	+	-	-	+
4	*S.* (s. str.) *aegyptiaca* Rohdendorf, 1935	-	-	-	-	-	-	-	-	-	+
5	*S.* (s. str.) *caspica* Rohdendorf, 1935	-	-	-	-	-	-	-	-	-	+
6	*S.* (s. str.) *deserta* Rohdendorf, 1935	-	-	-	-	-	-	-	-	-	+
7	*S.* (s. str.) *efflatouni* (Rohdendorf, 1935)	-	-	-	-	-	-	-	-	-	+
8	*S.* (s. str.) *tricuspis* (Meigen, 1838)	+	-	-	+	-	-	+	+	-	+
9	*Eremasiomya macularis* (Wiedemann, 1824)	-	-	-	-	-	-	-	-	-	+
10	*E. meridionalis* (Rohdendorf, 1927)	-	-	-	-	-	-	-	-	-	+
11	*E. nigra* Rohdendorf, 1935	-	-	-	-	-	-	-	-	-	+
12	*E. thereomyioides* Rohdendorf, 1935	-	-	-	-	-	-	-	-	-	+
13	*Protomiltogramma aegyptiaca* (Rohdendorf, 1934)	-	-	-	-	-	-	-	-	-	+
14	*P. fasciata* (Meigen, 1824)	-	-	+	+	-	+	-	-	-	+
15	*P. immunita* (Villeneuve, 1923), **comb. n.**	-	-	-	-	-	-	-	-	-	+
16	*P. obscurior* (Villeneuve, 1916)	-	-	-	-	-	-	-	-	-	+
17	*Pterella convergens* (Pandellé, 1895)	-	-	-	-	-	+	-	-	-	-
18	*P. grisea* (Meigen, 1824)	-	-	-	-	-	-	-	+	-	-
19	*P. melanura* (Meigen, 1824)	-	-	-	-	-	-	-	+	-	-
20	*P. nigrofasciata* (Rohdendorf, 1935)	-	-	-	-	-	-	-	-	-	+
21	*Achaetocephalon nudum* (Rohdendorf, 1934)	-	-	-	-	-	-	-	-	-	+
22	*Anacanthothecum testaceifrons* (Roser, 1840)	-	-	-	+	-	-	-	-	-	-
23	*Capnopteron africanum* (Verves, 1979)	-	-	-	-	-	-	-	-	-	+
24	*C. maroccanum* (Séguy, 1941)	-	-	-	+	-	-	-	-	-	+
25	*Cylindrothecum ibericum* (Villeneuve, 1912)	-	-	-	-	-	+	-	-	-	-
26	*Efflatounomyia albidopilosa* Rohdendorf, 1934	-	-	-	-	-	-	-	-	-	+
27	*E. pardalina* Rohdendorf, 1934	-	-	-	-	-	-	-	-	-	+
28	*Miltogramma algira* Macquart, 1843	-	-	-	-	-	+	-	-	-	+
29	*M. aurifrons* Dufour, 1850	-	-	+	+	-	+	+	-	+	+
30	*M. brevipila* Villeneuve, 1911	-	-	-	-	-	-	+	-	-	+
31	*M. germari* Meigen, 1824	-	-	-	+	-	+	-	-	-	+
32	*M. murina* Meigen, 1824	-	-	-	+	-	-	+	+	+	-

[4] Legend: "+" – species recorded after previous publications; "*" - species firstly recorded; "-" – species not recorded.

33	*M. oestracea* (Fallén, 1820)	-	-	-	-	-	+	-	-	+	+
34	*M. punctata* Meigen, 1824	-	-	+	-	-	+	+	-	-	+
35	*M. ruficornis* Meigen, 1824	-	-	-	-	-	-	-	+	-	-
36	*M. tunesica* (Enderlein, 1936)	-	-	-	-	-	-	+	-	-	-
37	*M. villeneuvei* Verves, 1982	-	-	-	-	-	-	-	-	-	+
38	*Miltogrammidium albifacies* (Villeneuve, 1929)	-	-	-	-	-	-	-	-	-	+
39	*M. chivae* (Rohdendorf, 1935)	-	-	-	-	-	-	-	-	-	+
40	*M. efflatouni* (Rohdendorf, 1934)	-	-	-	-	-	-	-	-	-	+
41	*M. rutilans* (Meigen, 1824)	-	-	-	-	-	-	-	+	-	-
42	*Craticulina barbifera* (Pandellé, 1895)	-	-	-	-	-	-	-	-	-	+
43	*C. bequaerti* Venturi, 1958	-	-	-	+	-	-	-	-	-	+
44	*C. diffusa* Villeneuve, 1934	-	-	-	-	-	-	-	-	-	+
45	*C. tabaniformis* (Fabricius, 1805)	-	-	-	+	-	+	-	+	+	+
46	*Apodacra chrysocephala* Rohdendorf, 1925	-	-	-	-	-	-	-	-	-	+
47	*A. seriemaculata* Macquart, 1854	-	-	-	-	-	-	-	-	-	+
48	*Xeromyia africana* (Rohdendorf, 1930)	-	-	-	+	-	-	-	-	-	-
49	*X. algiralis* (Séguy, 1941)	-	-	-	-	-	+	-	-	-	+
50	*X. dasystigma* (Rohdendorf, 1934)	-	-	-	-	-	-	-	-	-	+
51	*X. merei* (Séguy, 1941)	-	-	-	-	-	+	-	-	-	-
52	*X. orthogona* (Rohdendorf, 1925)	-	-	-	-	-	-	-	-	-	+
53	*X. stenorhina* (Rohdendorf, 1934)	-	-	-	-	-	-	-	-	-	+
54	*X. sulcata* (Villeneuve, 1933)	-	-	-	-	-	-	-	-	-	+
55	*Xerophilomyia cyprica* (Rondani, 1859)	-	-	-	-	-	-	-	-	-	+
56	*X. nigropicta* Rohdendorf, 1934	-	-	-	-	-	-	-	-	-	+
57	*X. plumipes* (Villeneuve, 1933)	-	-	-	+	-	-	+	-	-	+
58	*Amobia oculata* (Zetterstedt, 1844)	-	-	-	-	-	+	-	-	-	-
59	*A. signata* (Meigen, 1824)	+	-	+	+	-	+	+	+	+	-
60	*Sphecapatodes ornatus* Villeneuve, 1912	-	-	-	-	-	-	+	-	-	+
61	*Dolichotachina marginella* (Wiedemann, 1830)	-	-	-	+	-	+	+	-	+	+
62	*Hoplacephala hirtifrons* (Villeneuve, 1929)	-	-	-	-	-	-	-	-	-	+
63	*Prohoplacephala hafezi* (Rohdendorf, 1975)	-	-	-	-	-	-	-	-	-	+
64	*Metopodia pilicornis* (Pandellé, 1895)	-	-	-	-	-	+	-	-	-	-
65	*Alusomyia transfuga* Villeneuve, 1933	-	-	-	-	-	-	-	-	-	+
66	*Sphecapatoclea excisa* Villeneuve, 1909	-	-	-	-	-	-	-	-	-	+
67	*S. ghoulensis* Rohdendorf, 1975	-	-	-	-	-	-	-	-	-	+
68	*S. minor* Villeneuve, 1912	-	-	-	-	-	+	-	-	-	-
69	*Metopia argyrocephala* (Meigen, 1824)	-	-	-	-	-	*	-	-	-	-
70	*Phrosinella fedtshenkoi* Rohdendorf, 1925	-	-	-	-	-	*	-	-	-	-
71	*P. nasuta* (Meigen, 1824)	-	-	-	-	-	+	-	-	+	+
72	*P. zarudnoji* Rohdendorf, 1971	-	-	-	-	-	-	-	-	-	*
73	*Hilarella hilarella* (Zetterstedt, 1844)	-	-	+	-	-	-	-	-	-	-
74	*H. stictica* (Meigen, 1830)	-	-	-	-	-	+	-	-	-	-
75	*Paragusia albina* (Rohdendorf, 1935)	-	-	-	-	-	-	-	-	-	*
76	*P. elegantula* (Zetterstedt, 1844)	-	-	-	-	-	-	-	-	-	*
77	*P. multipunctata* (Rondani, 1859)	-	-	+	-	-	*	+	+	-	+
78	*Taxigramma heteroneura* (Meigen, 1830)	-	-	+	+	-	+	-	-	-	+
79	*Sphenometopa* (*Euaraba*) *claripennis* (Villeneuve, 1933)	-	-	-	-	-	-	-	-	-	+
80	*S.* (*E.*) *efflatouni* (Villeneuve, 1933)	-	-	-	-	-	-	-	-	-	+
81	*S.* (*E.*) *fastuosa* (Meigen, 1824)	-	-	-	-	-	-	-	-	-	+
82	*S.* (*Sahararaba*) *elegans* (Rohdendorf, 1971)	-	-	-	-	-	-	-	-	-	+
(80 sp.) Miltogramminae, sum		**2**	**-**	**8**	**14**	**-**	**23**	**12**	**9**	**7**	**61**

83	*Sarcotachina aegyptiaca* Villeneuve, 1910	-	-	-	-	-	+	-	-	-	+
84	*S. umbrinervis* Villeneuve, 1910	-	-	-	-	-	-	-	-	-	+
(2 sp.) Eumacronychiinae, sum		-	-	-	-	-	**1**	-	-	-	**2**
85	*Nyctia halterata* (Panzer, 1798)	-	-	-	+	-	+	-	+	+	+
86	*N. lugubris* (Macquart, 1843)	-	-	+	-	-	+	+	+	-	-
87	*Agria affinis* (Fallén, 1817)	+	-	-	-	-	-	-	-	+	-
88	*Blaesoxiphella brevicornis* Villeneuve, 1912	-	-	-	-	-	+	-	-	-	-
89	*Sarcophila khrokaloe* sp. n.	-	-	-	-	-	*	-	-	-	-
90	*S. latifrons* (Fallén, 1817)	-	-	+	-	-	-	-	+	-	-
91	*S. meridionalis* Rohdendorf *et* Verves, 1982	-	-	-	-	-	+	-	+	-	+
92	*S. navara* Lehrer, 2003	-	-	-	-	-	-	-	-	-	+
93	*Wohlfahrtia aschersoni* (Enderlein, 1934)	-	-	-	-	-	-	-	-	+	+
94	*W. bella* (Macquart, 1839)	-	-	+	+	-	+	+	-	-	+
95	*W. brunnipalpis* (Macquart, 1851)	-	-	-	-	-	+	-	-	-	+
96	*W. erythrocera* Villeneuve, 1910	-	-	-	-	-	+	-	-	+	-
97	*W. indigens* Villeneuve, 1928	-	-	+	+	-	+	+	-	-	+
98	*W. magnifica* (Schiner, 1862)	-	-	-	+	-	+	+	-	+	+
99	*W. nuba* (Wiedemann, 1830)	-	-	-	+	-	-	+	-	-	+
100	*W. trina* (Wiedemann, 1830)	-	-	+	-	-	+	-	-	+	+
101	*W. villeneuvei* Salem, 1938	-	-	-	-	-	+	-	-	+	+
102	*Wohlfahrtiodes aemulus* Séguy, 1940	-	-	-	-	-	+	-	-	-	-
103	*W. nudus* Villeneuve, 1910	-	-	-	-	-	-	-	-	-	+
(19 sp.) Paramacronychiinae, sum		**1**	-	**5**	**5**	-	**13**	**5**	**2**	**7**	**12**
104	*Agriella algeriensis* (Townsend, 1919)	-	-	-	-	-	+	-	-	-	+
105	*A. pandellei* Villeneuve, 1911	-	-	-	-	-	+	+	-	-	-
106	*A. rufescens* (Villeneuve, 1928)	-	-	-	-	-	+	-	-	-	-
107	*A. setosa* Salem, 1938	-	-	-	-	-	-	+	-	+	+
108	*Agriella tunisia* (Pape, 1994)	-	-	-	-	-	-	+	-	-	-
109	*Blaesoxipha cochlearis* (Pandellé, 1896)	-	-	-	-	-	+	-	-	-	-
110	*B. colorata* Verves, 1985	-	-	-	-	-	+	-	-	-	-
111	*B. dupuisi* Léonide et Léonide, 1973	-	-	-	-	-	+	-	-	-	-
112	*B. grylloctona* Löw, 1861	+	-	-	-	-	-	-	-	-	+
113	*B. laticornis* (Meigen, 1826)	-	-	-	-	-	-	-	-	-	+
114	*B. litoralis* (Villeneuve, 1911)	-	-	-	+	-	+	-	-	-	-
115	*B. misriella* Lehrer, 2002	-	-	-	-	-	-	-	-	-	+
116	*B. pygmaea* (Zetterstedt, 1844)	-	-	-	+	-	-	-	-	-	-
117	*B. redempta* (Pandellé, 1896)	-	-	+	+	-	+	+	+	+	+
118	*B. rufipes* (Macquart, 1839)	+	-	+	-	-	+	-	-	-	+
119	*B. subcochlearis* Séguy, 1932	-	-	-	-	-	+	-	-	-	-
120	*B. ungulata* (Pandellé, 1896)	-	-	-	-	-	+	-	-	-	-
121	*Servaisia* (s. str.) *rossica* (Villeneuve, 1912)	-	-	-	+	-	-	-	-	-	-
122	*Ravinia pernix* (Harris, 1780)	+	-	+	+	-	+	+	+	+	+
123	*Helicophagella* (s. str.) *noverca* (Rondani, 1860)	-	-	-	-	-	-	-	+	-	+
124	*H.*(s. str.) *novercoides* (Böttcher, 1913)	-	-	-	-	-	*	-	-	-	+
125	*H.*(s. str.) *rosellei* (Böttcher, 1912)	-	-	-	-	-	-	-	+	-	+
126	*H.* (*Parabellieria*) *maculata* (Meigen, 1835)	+	-	+	+	-	+	+	-	-	+
127	*H.* (*P.*) *melanura* (Meigen, 1826)	-	-	+	+	-	+	+	+	+	+
128	*Beziella* (*Brasia*) *kadeisi* (Salem, 1938)	-	-	-	-	-	-	-	-	-	+
129	*Artamonoviella monspellensia* (Böttcher, 1913)	-	-	-	-	-	*	+	+	-	-
130	*Discachaeta kunonis* Pape, 1986	-	+	-	-	-	-	-	-	-	-
131	*Heteronychia* (*Asceloctis*) *amputata* (Pape, 1990)	-	+	-	-	-	-	-	-	-	-

132	*H.* (*A.*) *balanina* (Pandellé, 1896)	-	-	-	+	-	-	-	-	-	-
133	*H.* (*A.*) *desertorum* (Salem, 1935)	-	-	-	-	-	-	-	-	-	+
134	*H.* (*A.*) *ferox* (Villeneuve, 1908)	-	-	+	+	-	+	+	+	-	-
135	*H.* (*A.*) *mariutana* (Salem, 1935)	-	-	-	-	-	-	-	-	-	+
136	*H.* (*Boettcherella*) *setinervis* (Rondani, 1860)	-	-	-	-	-	-	-	-	-	+
137	*H.* (*Ctenodasypygia*) *graeca* (Rohdendorf, 1937)	-	-	-	-	-	*	-	-	-	-
138	*H.* (*C.*) *minima* (Rondani, 1862)	-	-	-	+	-	+	+	+	-	+
139	*H.* (*C.*) *penicillata* (Villeneuve, 1907)	-	-	-	+	-	+	+	+	-	-
140	*H.* (*C.*) *santospintosi* (Lehrer & Báez, 1986)	-	-	+	-	-	-	-	-	-	-
141	*H.* (*C.*) *siciliensis* (Böttcher, 1913)	-	-	+	-	-	-	-	-	-	+
142	*H.* (*C.*) *thirionae* (Lehrer, 1976)	-	-	-	-	-	+	-	-	-	-
143	*H.* (*C.*) *tricolor* (Villeneuve, 1908)	-	-	+	-	-	-	-	-	-	-
144	*H.* (*C.*) *uncicurva* (Pandellé, 1896)	+	-	+	-	+	*	+	+	-	-
145	*H.* (*C.*) *villeneuveana* (Enderlein, 1928)	-	-	-	+	-	+	+	+	-	-
146	*H.* (s. str.) *amica* Peris, González-Mora *et* Mingo, 1998	-	-	-	+	-	-	-	-	-	-
147	*H.* (s. str.) *benaci* (Böttcher, 1913)	-	-	-	-	-	-	-	+	-	-
148	*H.* (s. str.) *bulgarica* (Enderlein, 1936)	-	-	-	-	-	-	-	+	-	-
149	*H.* (s. str.) *consanguinea* (Rondani, 1860)	-	-	-	-	-	+	-	-	-	-
150	*H.* (s. str.) *depressifrons* (Zetterstedt, 1845)	-	-	-	-	-	-	-	+	-	-
151	*H.* (s. str.) *haemorrhoides* (Böttcher, 1913)	-	-	-	-	-	-	-	+	-	-
152	*H.* (s. str.)*metopina* (Villeneuve, 1908)	-	-	+	-	-	-	-	-	-	-
153	*H.* (s. str.) *pandellei* (Rohdendorf, 1937)	-	-	-	-	-	+	+	-	-	-
154	*H.* (s. str.) *proxima* (Rondani, 1860)	-	-	-	-	-	-	-	-	+	-
155	*H.* (s. str.) *tunisiae* (Whitmore, 2011)	-	-	-	-	-	-	+	-	-	-
156	*H.* (*Pandelleola*) *filia* (Rondani, 1860)	-	-	-	+	-	-	-	+	-	-
157	*H.* (*P.*) *sicilia* (Pape, 1996)	-	-	-	-	-	-	-	+	-	-
158	*Karovia hirticrus* (Pandellé, 1896)	-	-	-	-	-	+	-	+	-	-
159	*Notoecus longestylatus* (Strobl, 1906)	-	-	-	+	-	+	+	-	-	-
160	*Krameromyia anaces* (Walker, 1849)	-	-	-	-	-	+	-	-	-	-
161	*Myorhina* (s. str.) *nigriventris* (Meigen,1826)	-	-	-	+	-	+	+	+	+	-
162	*M.* (s.str.) *soror* (Rondani, 1860)	-	-	+	-	-	-	-	-	-	-
163	*Pandelleana berberina* Lehrer, 2003	-	-	-	+	-	-	-	-	-	-
164	*Pseudothyrsocnema spinosa* (Villeneuve, 1912)	-	-	-	-	-	-	-	-	-	+
165	*Sarina sexpunctata* (Fabricius, 1805)	-	-	+	-	-	-	-	-	-	-
166	*Thyrsocnema belgiana* Lehrer, 1976	-	-	-	-	-	*	-	-	-	-
167	*T. incisilobata* (Pandellé, 1896)	-	-	-	-	-	+	-	-	-	-
168	*Transvaalomyia rohdendorfi* (Salem, 1936)	-	-	-	-	-	-	-	-	-	+
169	*Phytosarcophaga* (s. str.) *destructor* (Malloch, 1929)	-	-	-	-	-	-	-	+	-	+
170	*Bercaea africa* (Wiedemann, 1824)	+	+	+	+	-	+	+	+	+	+
171	*Liopygia* (*Engelisca*) *surcoufi* (Villeneuve, 1913)	+	-	-	-	-	+	+	-	-	+
172	*L.* (*Jantia*) *crassipalpis* (Macquart, 1839)	+	+	+	+	-	+	+	+	+	+
173	*L.* (*Thomsonea*) *argyrostoma* (Robineau-Desvoidy, 1830)	+	+	+	-	-	+	+	+	-	+
174	*Liosarcophaga* (*Curranea*) *tibialis* (Macquart, 1851)	+	+	+	-	-	+	+	+	+	+
175	*L.*(s. str.) *aegyptica* (Salem, 1935)	-	-	-	-	-	-	-	-	-	+
176	*L.*(s. str.) *catalunya* Lehrer, 2008	-	-	-	-	-	+	-	-	-	-
177	*L.*(s. str.) *deviedmai* (Lehrer & Baez, 1986)	-	-	+	-	-	-	-	-	-	-
178	*L.*(s. str.) *dux* (Thomson, 1869)	+	-	+	+	-	-	+	+	+	+

179	*L.*(s. str.) *ismailiana* Lehrer, 1998	-	-	-	-	-	-	-	-	-	+
180	*L.*(s. str.) *jacobsoni* (Rohdendorf, 1937)	+	-	+	+	+	+	+	+	-	+
181	*L.*(s. str.) *madeirensis* (Schiner, 1869)	-	+	-	-	-	-	-	-	-	-
182	*L.*(s. str.) *marshalli* (Parker, 1923)	-	-	-	+	-	+	+	+	-	+
183	*L.*(s. str.) *mennae* (El-Ahmady, Taha, Soliman & El-Hawagry, 2018)	-	-	-	-	-	*	-	-	-	-
184	*L.*(s. str.) *parkeri* (Rohdendorf, 1937)	-	-	-	-	-	-	-	-	-	+
185	*L.*(s. str.) *pharaonis* (Rohdendorf, 1934)	-	-	-	+	-	-	+	-	-	+
186	*L.*(s. str.) *portschinskyi* (Rohdendorf, 1937)	-	-	-	+	-	*	-	-	-	-
187	*L.*(s. str.) *redux* (Walker, 1849)	-	-	-	-	-	-	-	-	-	+
188	*L.*(s. str.) *teretirostris* (Pandellé, 1896)	-	-	-	+	-	*	-	+	-	-
189	*L.*(s. str.) *tuberosa* (Pandellé, 1896)	+	-	-	-	-	-	-	-	-	-
190	*L.* (*Pandelleisca*) *similis* (Meade, 1876)	+	-	-	-	-	-	-	-	-	-
191	*L.* (*Pharaonops*) *tewfiki* (Salem, 1940)	-	-	-	-	-	-	-	-	-	+
192	*Parasarcophaga* (s. str.) *albiceps* (Meigen, 1826)	-	-	-	-	-	+	-	-	-	+
193	*P.* (s. str.) *hirtipes* (Wiedemann, 1830)	-	-	-	+	-	+	-	-	-	+
194	*Stackelbergeola grueti* Lehrer, 2000	-	-	-	-	-	-	-	-	-	+
195	*Sarcophaga carnaria* (Linnaeus, 1758)	-	-	-	-	-	-	-	+	-	-
196	*S. lehmanni* Müller, 1922	-	-	-	+	-	+	+	+	-	+
197	*S. marcelleclercqi* Lehrer, 1975	-	-	-	+	-	-	-	-	-	-
198	*S. subvicina* Rohdendorf, 1937	-	-	-	-	-	-	+	-	-	-
199	*S. variegata* (Scopoli, 1763)	-	-	-	+	-	+	-	+	-	+
(96 sp.) Sarcophaginae sum		**14**	**7**	**20**	**29**	**2**	**46**	**28**	**31**	**10**	**41**
Sarcophagidae total		**17**	**7**	**33**	**49**	**2**	**84**	**45**	**43**	**24**	**116**

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)

HALTERES, Volume 10, 75-79, 2019
doi: 10.5281/zenodo.3594370

New records of two genera of Mymaridae (Hymenoptera:Chalcidoidea) from Northeast India

Bankerdonbor Kharbisnop and Sudhanya R. Hajong*

Department of Zoology, North-Eastern Hill University, Shillong-793022, Meghalaya, India.

(Email: srhajong@nehu.ac.in)

Abstract

The paper reports the occurrence of the two genera of Mymaridae viz., *Narayanella* Subba Rao, 1976 with record of one species - *Narayanella pilipes* Subba Roa, 1976 from Khasi Hills, Meghalaya and the genus *Eubroncus* Yoshimoto, Kozlov and Trjapitzin, 1972 with two species viz., *E. indicus* Hayat & Khan, 2009 and *E. scutatus* Manickavasagam & Palanivel, 2015.

Keywords: *New records, Mymaridae, Meghalaya, Northeast India.*

Received: 21 January 2018; Revised: 28 December 2019; Online: 31 December 2019

Introduction:

The family Mymaridae currently consists of 109 genera and 1457 species known globally (Aguiar *et al.*, 2013). From India, 38 genera and 194 species are recorded (Manickavasagam and Athithya, 2018). Commonly referred to as fairy flies, they are tiny in size ranging from 0.5- 1.00 mm in length. They are non metallic and are usually black, brown or yellow.

From Meghalaya, including Northeast India, there are only few trace and fragmentary reports available on these insects. As per the checklist of Mymaridae compiled by Manickavasagam and Athithya (2018), a total of 31 species belonging to 17 genera are reported from various districts of Meghalaya.

The present paper reports the occurrence of the two genera of Mymaridae viz., *Narayanella* Subba Rao, 1976 with the occurrence of one species - *Narayanella pilipes* Subba Roa, 1976 from Khasi Hills of Meghalaya and *Eubroncus* Yoshimoto, Kozlov and Trjapitzin with two species - *E. indicus* Hayat & Khan, 2009 and *E. scutatus* Manickavasagam & Palanivel, 2015 from Khasi Hills of Meghalaya.

Materials and Methods

Specimens were collected from the forests of Upper Shillong, Mawsynram and Nongkhyllem using yellow pan traps. The collected specimens were mounted in Canada balsam following the method described by Noyes (1982). Photographs were taken with a Sony digital camera under Leica microscope. Measurements were made from slide-mounted specimens using a compound microscope. All measurements are given in millimeters (mm). Specimens collected are deposited in Entomology Laboratory, Department of Zoology, North Eastern Hill University, Shillong, Meghalaya, India and also in the Entomology Laboratory, Annamalai University, Tamil Nadu.

Observations:

1. Genus *Eubroncus*

Eubroncus Yoshimoto, Kozlov & Trjapitzin, 1972: 879.

Type species: *Eubroncus orientalis* Yoshimoto, Kozlov & Trjapitzin, 1972, by original designation.

Stomarotrum Yoshimoto, Kozlov & Trjapitzin, 1972: 879.

Type species: *Stomarotrum prodigiosum* Yoshimoto, Kozlov & Trjapitzin, 1972, by original designation; synonymy of

Eubroncus by Triapitsyn and Huber 2000: 603.

Diagnosis: Head sub-triangular in lateral view. Vertex smooth with a pair of placoid sensilla in front of post ocelli. Mandibles long and narrow, with strong apical teeth. Female antenna with funicle 6-segmented and clava 1-segmented. Pedicel longer than fl1. Pedicel, funicle (fl1–fl6) and clava with numerous multiporous plate sensilla; few in scape. Hind wing wide and broadly with rounded apex. Abdomen with 4 ridges. Tarsi 4-segmented. Protibial bears non uniform spur.

***Eubroncus indicus* Hayat and Khan, 2009**

Female (Figure 1): Body length= 1.62 mm, Head = 0.35 mm; vertex smooth = 0.05 mm. Mid ocellus = 0.025 mm. Antenna darkish brown with light brown radical; flagellum clavate with funicle 6-segmented, clava 1-segment with radical = 0.06 mm. Scape = 0.2 mm; pedicel = 0.063 mm. Scape, pedicel, funicle (fl1–fl6) and clava with numerous multiporous plate sensilla. Eyes pinkish-red wine in colour; sub-triangular measuring 0.1 mm. Mandible 0.24 mm with prominent teeth. Mesosoma metallic darkish brown measuring 0.52 mm. The pronotum 0.11 mm. Mesoscutum 0.225 mm reticulate with a pair of strong setae at postero-lateral angle, lateral lobes also sculptured with a seta in each lobe postero-laterally. Forewing 1.125 mm and hind wing 0.9 mm. Legs light brown. Ovipositor yellowish. Axilla with longitudinal carinae laterally fading towards anterior scutellum. Each axilla bearing one strong seta, posterior end with reticulate sculpture. Scutellum measuring 0.18 mm, anterior part bearing two placoid sensillae at the middle. Post scutellum with 2–3 longitudinal carinae on lateral sides and strongly foveate on the entire anterior margin; Propodeum 0.31 mm with strong reticulate sculpture medially and laterally and with a pair of setae. Mesophragma broadly 'v' shaped almost reaching posterior margin of propodeum. Gaster measures 0.42 mm, somewhat oval in shape showing ridges at the dorsal and ventral posterior part; petiole 0.157 mm with antero-lateral spines. Ovipositor 0.15 mm slightly exerted, as long as mesotibia.

Materials examined: 3♀, India, North East, Meghalaya, Upper-Shillong, 1652m, 25°32'51.09''N and 91°51'11.32''E, 5.iv.2017, Coll. B. Kharbisnop.

Distribution: West Bengal: Darjeeling (Hayat and Khan, 2009), Meghalaya (New Record).

***Eubroncus scutatus* Manickavasagam and Palanivel, 2015**

Female (Figure 2): Body length = 1.22 mm. Head 0.375 mm. Antenna 6-segmented; clava 1-segment 0.2 mm; scape measuring 0.2 mm; pedicel 0.075 mm. Mandible 0.225 mm as long as the head with prominent teeth. Thorax as the length of the gaster measuring 0.463 mm; mesoscutum 0.3 mm; propodeum 0.125 mm; scutellum 0.2 mm. Forewing 1.43 mm and hind wing 1.025 mm. Legs approximately 1.05 mm, ovipositor slightly exerted measuring 0.125 mm. Gaster globulose measuring 0.487 mm. Petiole 0.087 mm.

Material examined: 1♀, 5.iv.2017; 2♀, 9. v. 2017, India, North East, Meghalaya, Upper-Shillong, 1652m, 25°32'51.09''N and 91°51'11.32''E, Coll. B. Kharbisnop.

Distribution: Karnataka and Tamil Nadu (Palanivel and Manickavasagam, 2015), Meghalaya (New Record).

2. Genus *Narayanella*

Narayana, Subba Rao, Orient. Ins., 10 (1): 87. 1976 (preoccupied in Distant, 1908).

Narayanella, Subba Rao, Orient. Ins., 10 (3): 352. 1976

Narayanella, Subba Rao & Hayat, Contr. A mer. ent. Inst., 20: 138. 1983

Diagnosis: Hind legs with exceedingly long spiny hairs; hind coxae longer than petiole; fore wings with cilia in curved alternately strong and weak rows; terminal funicular segment forming club.

***Narayanella pilipes* Subba Rao, 1976**

Female (Figure 3): The body length = 2.6 mm. Head oval, broader than long measuring 0.35-0.37/0.24-0.23 mm. Mandible as long as maxilla. Ocelli three, arranged in triangular fashion; middle ocellus much bigger than the

Figure 1-3. Body Profile of: **1.** *Eubroncus indicus* (40x); **2.** *Eubroncus scutatus* (40x); **3.** *Narayanella pilipes* (40x).

two measuring 0.03 mm. Antenna multi-coloured; brown with some part darkish brown and white; scape = 0.07-0.1 mm; pedicel = 0.03-0.075 mm; funicle 7-segmented, 1st segment brown (0.12 mm), 2nd and 3rd darkish brown and the longest among the funicles measures 0.25 mm each, the 4th (0.18 mm) and 5th (0.08 mm) segments white and the 6th segment (0.11 mm) black and clava 1-segment measuring 0.375mm black with 8 multiporous plate sensilla. Thorax smooth, elongated, measures 0.75-0.87 mm; pronotum 0.20-0.23/0.20-0.24 mm; mesoscutum 0.07-0.08/0.19-0.27 mm; scutellum 0.14-0.18/0.18-0.20 mm; propodeum 0.10-0.12 mm. Forewing 1.8/0.40-2.30/0.43 mm supported by the distribution of strong cilia arranging in a discoidal pattern. Hind wing 1.50/0.05-1.55/0.05 mm. Legs elongated; fore and mid leg measures 1.80 mm, 2.04 mm, and hind leg very long with 2.89 mm. Petiole 0.54-0.6 mm. Gaster ovate 0.74/0.42-0.875/0.45 mm bearing ovipositor.

Male: Unknown; **Host**: Unknown

Material examined: 6 ♀, India, North East, Meghalaya, Ingkyrsa, 1214m, 25°14'30.28"N and 91°27'40.90"E, 9.x.2017 (Yellow Pan Trap); 1 ♀, Nongkhyllem Wildlife Sanctuary, Nongpoh, 25°55'24.58''N and 91°49'23.70"E. 18.viii.017 (Yellow Pan Trap). Coll. B. Kharbisnop.

Distribution: India: West Bengal (Hayat, 1992), Andhra Pradesh, Tamil Nadu (Manickavasagam and Rameshkumar, 2011),

Andaman and Nicobar Islands (Rameshkumar *et al.*, 2017), Uttarakhand (Joshi *et al.*, 2017) and Meghalaya (New record); Burma.

Comment: Collected specimens of *N. pilipes* are yellowish brown in colour with the exception of some antennal parts and legs which are white and dark brown. These specimens from Meghalaya show slight variations of the following features as compared to that described by Subba Rao.
(1) The 4th and 5th funicular segment, white in colour which differs from other existing species.
(2) 8 multiporous plate sensilla distributed in clava.
(3) Forewing well marked with patch and cilia are more distributed towards the base.
(4) Gaster oval in shape.

Acknowledgements

We would like to thank the head of the department of Zoology, NEHU for providing all the necessary facilities. BK is thankful to NEHU for UGC-Non NET fellowship. We are also grateful to Dr. Santhosh Shreevihar, Malabar Christian College, Kozhikode, Kerala for reviewing the paper.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 80-85, 2019
doi: 10.5281/zenodo.3596046

Description of a new species of *Lasiochalcidia* Masi (Chalcidoidea: Chalcididae) from India with a key to Oriental species

***C. Binoy[1,3], P.M. Sureshan[2], S. Santhosh[3] and M. Nasser[1]**

[1]*Insect Ecology and Ethology Laboratory, Department of Zoology, University of Calicut, Kerala-673635, India.*
[2] *Western Ghats Regional Centre, Zoological Survey of India, Eranhipalam, Kozhikode, Kerala-673006, India.*
[3] *Systematic Entomology Laboratory, Malabar Christian College, (Affiliated to University of Calicut), Kozhikode, Kerala-673001, India.*

(Email: binoy_doz@uoc.ac.in)

Abstract

***Lasiochalcidia* Masi, 1929 (Hymenoptera: Chalcididae) is one of the rarest chalcid genera to have been recorded from the world. Association with antlions and the peculiar mode of oviposition makes the genus more interesting. Here we describe and illustrate a new species of *Lasiochalcidia* Masi with a key to Oriental species.**

Keywords: *Chalcididae; Lasiochalcidia Masi; New Species; India; Oriental Region.*

Received: 11 July 2019; Revised: 26 December 2019; Online: 31 December 2019

Introduction

Lasiochalcidia Masi, 1929 is one of the least common genera of hybothoracine (Haltichellinae: Hybothoracini) tribe to occur in any collection from the tropics. Presently constituting of 23 species worldwide, the species is mostly associated as parasitoids of antlion larvae (Neuroptera: Myrmeleontidae) (Nikol'skaya, 1978; Bouček 1988; Noyes, 2019). The genus is represented by seven species from the Oriental region of which only two species are recorded from the Indian subcontinent *viz., L. dargelasii* (Latreille, 1805) and *L. pilosella* (Cameron, 1904).

Host association and the mode of parasitisation of species in *Lasiochalcidia* have been of much interest. Bouček (1956) reported Lepidopteran pupae as hosts for *Lasiochalcidia* species, but this is very doubtful as *Lasiochalcidia* is commonly regarded as a potential parasitoid of much voracious predators, the ant-lion larvae (Lotfalizadeh *et al.*, 2012). The peculiarity in oviposition is described by many as a spectacle to watch.

Stefan (1958, 1959, 1961, 1966) studied the ovipositional behaviour of several species of *Lasiochalcidia* and found their innate ability to discover hidden hosts by perceiving the movements on loose soil made by the antlion larva, using the specialised mechanoreceptors on the antennae. The female parasitoid provokes the antlion larva to attack its hindlegs with the powerful and deadly mandibles of antlion larva. When the antlion grabs on, the toothed mandibles get held on by the rugate basal teeth of the hindlegs of the parasitoid. Now, parasitoid stretches the antlion's jaws apart using its muscular legs making the predator helpless and expose its most vulnerable and least chitinous part of its body, the ventral side of its neck. The parasitoid takes its time and carefully oviposit an egg through the antlion's exposed throat not harming any of its vital organs. The task when completed, the parasitoid releases the helpless antlion larva from its hold and flies off. The antlion larva is thus left to rot while the parasitoid lives within its body and the adult wasp emerges off the pits build by antlion larva when they fully mature.

Materials and Methods

The specimens for the present study was retrieved employing both sweeping from

an abandoned vegetable field in Edakkara and by passive yellow pan trap collections from Jafferkhan colony, Kozhikode district and near D. B. College, Shasthamkotta in Kollam district of Kerala, India. The specimens were preserved in 70% ethyl alcohol and later card mounted for microscopic observation. The parasitoids were examined under a stereoscopic binocular microscope of model LEICA M205 and the images were captured with the camera model LEICA DFC 500. Measurements were obtained using Leica LAS (Leica Application Suite V3.80) microsystems by Leica (Heerburg, Switzerland). Images at varying depth were stacked using Leica Auto montage Software V3.80 and the final illustrations were post-processed for contrast and brightness using Adobe® Photoshop® CS5 (Version 12.0 x64) software. The type specimens are deposited in the National Zoological collections of Zoological Survey of India, Western Ghat Regional Centre, Kozhikode (ZSIK).

Terms and measurements: The terminology used is mainly that of Narendran (1989) and Narendran & van Achterberg (2016). The nomenclature for cuticular sculpturing follows Harris (1979).The general abbreviations of the terms are as follows:

F1–F7: First to seventh funicular segments
MV: Marginal vein
OD: Diameter of median ocellus
OOL: Minimum distance between posterior ocelli and compound eye
PMV: Postmarginal vein
POL: Distance between two posterior ocelli
STV: Stigmal vein
T1-T6: Abdominal tergites one to six

Results and Discussion

Genus *Lasiochalcidia* Masi, 1929

Anoplochalcidia Steffan, 1951: 2. Type species: *Anoplochalcidia guineensis* Steffan, original designation and monotypy

Dromochalcidia Masi, 1929: 185. Type species: *Dromochalcidia moluccensis* Masi, by monotypy

Lasiochalcidia Masi, 1929: 209-220. Type species: *Euchalcis rubripes* Kieffer, by subsequent designation of Nikol'skaya, M. (1952).

Lasiochalcidia (*Anoplochalcidia*) Steffan, 1953: 34. New status for *Anoplochalcidia* Steffan (page 34)

Oxycoryhpus Cameron, 1904: 109. Type species: *Oxycoryhpus pilosellus* Cameron, by monotypy

Oxycoryphiscus Ghesquiere, 1946: 368. Replacement name for *Oxycoryphus* Cameron, 1904 nec Fischer, 1853.

Diagnosis: Temples almost lacking in profile, vertex above in anterio-posterior view very thin; frons and gena covered with thick silvery bristles; posterior margin of pronotum with a border of minute bristles; scutellum apically often bidentate, propodeum sloping steeply onto gaster; scape in males often with prominent horn like dent below.

Hosts: Most species of the genus are parasites on antlion larvae (Neuroptera: Myrmeleon-tidae) (Bouček, 1988; Noyes, 2019).

Distribution: This genus is distributed in Africa, Europe and Asia (Noyes, 2019).

Key to Oriental species of *Lasiochalcidia* Masi

(Modified from Narendran, 1989)

1. Females.....2
– Males.....6
2. Hind femora less than 2× as long as wide; distal half not narrower than proximal (equal to subequal) half; scrobal striations narrow, slightly convex.....3
– Hind femora distinctly more than 2× as long as wide; distal half a trifle narrower than proximal half; other characters partly or completely different.....4
3. Hind femora distinctly much less than 2× as long as wide; scrobal striae strong and narrowed; apex of scutellum well emarginate; T1 smooth and shiny..... ..... ***L. pilosella* (Cam.)**
– Hind femora less than or equal to 2× as long as wide; scrobal striae weak and wider than in alternate; apex of scutellum weakly emarginate to rounded; T1 shagreened .....***L. narendrani* Binoy and Sureshan sp.n.**
4. Apex of scutellum prominently bilobate; hind femora black; propodeum with median area with several longitudinal carinae.....***L. moluccensis* (Masi)**

– Apex of scutellum weakly emarginate; hind femora usually red, propodeum without longitudinal carinae 5
5. Striations of scrobe almost straight; apex of scutellum produced in the form of a flange; propodeum with lateral teeth weak; antennae and legs completely rufous.....***L. thresiae*** **Narendran**
– Striations of scrobe convex; apex of scutellum bidentate; propodeum with prominent lateral teeth; antennae, fore and mid femora and hind tibiae usually blackish..... ***L. dargelasii*** **(Lat.)**
6. Antenna with scape without a prominent dent below.....***L. narendrani*** **Binoy and Sureshan sp.n.**
– Antenna with scape having a prominent dent below.....7
7. Apex of scutellum deeply or well incised and bilobate.....8
– Apex of scutellum hardly emarginate, almost entire.....***L. dargelasii*** **(Lat.)**
8. Hind leg black.....***L. birmanus*** **(M.&D.)**
– Hind leg red.....***L. pilosella*** **(Cam.)**

Lasiochalcidia narendrani Binoy and Sureshan sp.n.

(Figures 1–7)

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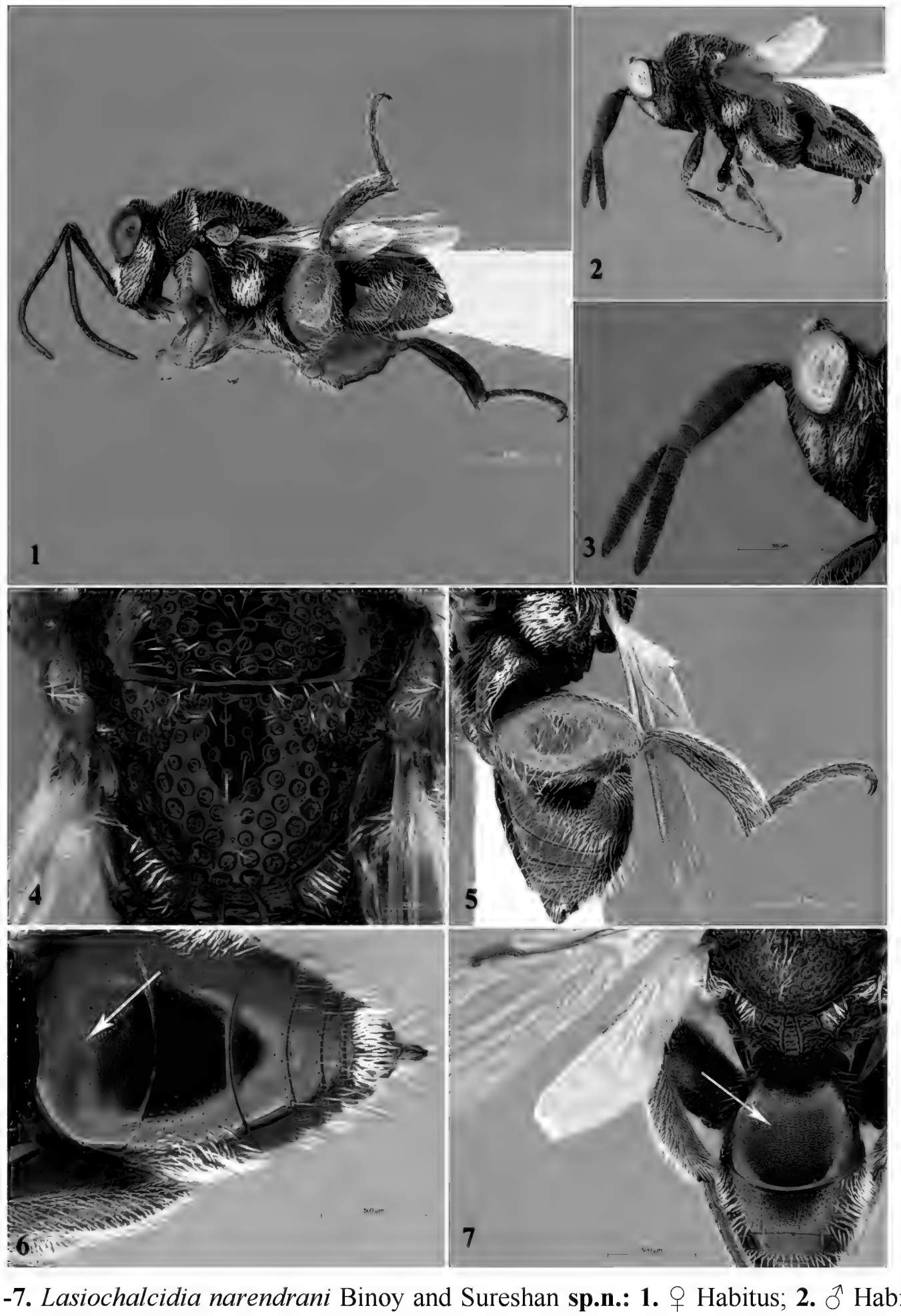
Diagnosis: The new species comes close to *L. pilosella* in general morphology in the key to Oriental species of *Lasiochalcidia* (Narendran, 1989) in having the hind leg less than a trifle of 2× as long as wide and both proximal and distal ends of same width; but differs from the same in having scrobal striations wider and weak (in *L. pilosella,* scrobal striation strong and narrow), apex weakly emarginate (in *L. pilosella,* scutellum apically well emarginate); T1 shagreened (in *L. pilosella,* T1 smooth and shiny); hind femur with a prominent lobe at apical end (in *L. pilosella* lobe indistinct or weak); scape in male without a dent below (in all other reported specimen, males with a distinct dent below).

Description: ***Female:*** Length 3.45–3.68 mm. Body black with the following parts as follows: head black with variation in pubescence, upper frons with golden yellow thin setae changing into thick silvery hairs on lower face and along genal margin; scape liver brownish to black, pedicel brown, F1 and F2 brownish black, remaining flagellar segments brownish black with apices brown, clava basally liver brownish, remaining portion brownish black; fore and mid femur and tibia reddish brown, fore and mid coxa black, all tarsi testaceous; hind coxa dorsally shiny black with fine setose punctures ventrally, hind femora reddish brown with black tooth at ventral margin and scattered pits on the disc arising from which are thin silvery white long hairs, hind tibia reddish brown dorsally, ventrally black, carinate, surface with scattered thin white hairs; gaster black with dense golden yellow pubescence laterally on T2 to T5; T6 completely covered with rows of golden yellow pubescence; pubescence on the body golden.

Head (Fig. 1–3): Head a trifle wider than width of thorax (excluding tegula), 1.86× as high as wide in lateral view, moderately punctate with thin golden yellow pubescence on the upper face extending to the occiput; lower face moderately punctate with dense silvery white pubescence extending to the gena; POL 3.25× OOL, median ocellus slightly larger than lateral ocelli, ocelli reddish brown forming a more or less obtuse isosceles triangle; scrobe shallow with narrow reticulations; eyes glabrous 1.43× as wide as long in lateral; antenna with scape longer than F2 to F6 combined, pedicel 1.56× as long as F1, clava more than twice as long as the preceding funicular; interocular space 2× as wide as scrobal; pre and postorbital carinae absent, gena wider than long, temples lacking.

Mesosoma (Figs. 4 & 5): Pronotum shiny black with umbilicate scattered pits with golden yellow setae and wide alutaceous interstices, posterior margin with a row of thick small golden yellow bristles; mesoscutum punctate with thin golden yellow pubescence and wide shiny to alutaceous interstices, scapula with an impunctate area in dorsal half; scutellum 1.04x as wide as long, anteriorly with small pits and smooth interstices, posteriorly size of the pits increases, reducing the size of shiny interstices, pubescence golden yellow; wings hyaline, sparse pilosity and deep brown veins, MV curving into a short STV, PMV absent; fore and mid legs reddish brown with coxae black, hind coxa black with ventro-apical reddish spot; hind femora reddish brown with sparse punctures and thin long silvery white



Figures 1-7. *Lasiochalcidia narendrani* Binoy and Sureshan **sp.n.: 1.** ♀ Habitus; **2.** ♂ Habitus; **3.** ♂ Head and antenna in profile; **4.** ♀ Thorax dorsal view; **5.** ♀ Hind leg in profile; **6.** ♀ Gaster in dorsal view; **7.** ♂ Gaster in dorsal view.

pubescence on inner and outer disc, inner disc smooth with very few punctures and setae, a prominent ventral tooth at basal third formed of several rugae followed by a long comb of minute black teeth terminating as a small lobe apically; hind tibia reddish brown with black carinate ventral portion; metapleura punctate with dense silvery white setae; propodeum subparallel to scutellum, slightly declining to metanotum with median areola, well defined submedian and sublateral carinae, lateral teeth prominent, callus with patch of thick silvery white setae.

Metasoma (Figs. 6 & 7): Sessile, a trifle shorter than mesosoma in profile, black, sub-acuminate apically with pubescence ventro-laterally along T2 to T5, T6 most pubescent, T1 with posterior margin convex, shagreened

anteriorly, posteriorly with a short smooth band, T2 longest, T2 to T6 posterior margin concave, T2 shagreened with scattered small setigerous pits, laterally moderately high pubescence; T3 to T5 smooth, shiny with short area just above the posterior margins shagreened with scattered pits, pubescence pale golden yellow; T6 with 5 rows of thick bristles, surface not visible due to pubescence; epipygium short with a pair of long setae; ovipositor sheath black, slightly visible dorsally; hypopygium with a pair of long white setae apically.

Male (Figs. 2, 3 & 7): Length 2.91–3.02 mm, stouter black specimen with compressed antennae, similar to ♀ in other features.

Host: Unknown

Material examined: Holotype: ♀, INDIA: KERALA, Jafferkhan colony, Kozhikode district (11°15'50.1"N & 75°11.5"E), Yellow pan trap, 14. iii. 2018. Coll. P. Girish Kumar, ZSIK Regd. No. ZSI/WGRC/ IR/ INV/ 12561. **Paratypes:** 3♀, 3♂ INDIA: KERALA, Edakkara abandoned vegetable field, Kozhikode district (11°22'33.5"N & 75°47'02. 8"E) Sweep net, 07. v. 2019. Coll. P.M. Sureshan and party, ZSIK Regd. No. ZSI/WGRC/IR/INV/12562–12567;1♂ INDIA: KERALA, near D. B. College, Shasthamkotta, Kollam district (9°02'25.8" N & 76°38'04.1" E), Yellow pan trap, 22.viii.2016. Coll. K.G. Emiliyamma and party, ZSIK Regd. No. ZSI/WGRC/IR/INV/12568.

Distribution: India: Kerala.

Etymology: Named in honour of Late Dr. (Prof.) T.C. Narendran for his great contributions to the knowledge of Oriental Hymenoptera.

Acknowledgements

The authors are grateful to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata; authorities at Department of Zoology, University of Calicut and Malabar Christian College, Kozhikode for providing facilities and encouragement. The present study was carried out as a part of Aspire Scholarship Scheme supported by Department of Collegiate Education, Government of Kerala.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 86-95, 2019
doi: 10.5281/zenodo.3596075

Taxonomic review of Indian species of the genus *Ceranisus* Walker (Chalcidoidea: Eulophidae)

***Mohd Majid Jamali[1], Shahid Bin Zeya[2] & Rayees Afzal Mir[1]**

[1]*Department of Agriculture, Glocal University, Saharanpur 247 121, Uttar Pradesh, India.*
[2]*Department of Zoology, Aligarh Muslim University, Aligarh 202 002, Uttar Pradesh, India.*

(Email: majidjamali1988@gmail.com)

Abstract

The Indian species of *Ceranisus* Walker (Eulophidae: Entedoninae) are reviewed. The review includes four species, of which *C. udnamtak* Triapitsyn is recorded for the first time from India. Male is described for the *Ceranisus udnamtak* Triapitsyn for the first time from the world.

Keywords: *Hymenoptera; Entedoninae; parasitoid; new record.*

Received: 24 January 2019; Revised: 31 December 2019; Online: 31 December 2019

Introduction

The species of genus *Ceranisus* Walker are considered as an important parasitoids, attacking the larval stage of thrips (Thysanoptera: Thripidae) (Schauff, 1991; Loomans, 2003; Triapitsyn, 2005). These are potential agents in the bio-control of thrips pests of economically important plants. Presently this genus contains 40 species from the world, of which only 3 species are known from India (Noyes, 2019).

In this paper, we record 4 species, of which *C. udnamtak* Triapitsyn, is a new record from India. All species are fully diagnosed and thoroughly illustrated and an identification key to Indian species is also provided.

Materials and Methods

The present study is based on a small collection of entedonine parasitoids (Hymenoptera: Eulophidae: Entedoninae) collected from the Indian states of Andhra Pradesh, Sikkim, Uttarakhand and Uttar Pradesh mainly by sweep net, otherwise noted under the section of material examined section. The body colour was noted from card mounted specimens before clearing and mounting the specimens on slides in canada balsam. Body length for the new species is given in millimetres. All other measurements are relative taken from the divisions of a linear scale of a micrometer placed in the eye piece of a compound microscope. These measurements were taken at 100× magnification of the microscope. The photographs of card mounted specimens were taken with digital camera (Nikon DS-Fi2) attached to a stereozoom (Nikon SMZ25) and the photographs of slide mounted parts were taken with a digital camera (Nikon DS-Fi1c) attached to a compound microscope (Nikon Eclipse Ci).

The following abbreviations are used in the text:
C1, C2 etc.: Clava segments 1, 2 etc.
F1, F2, etc.: Funicle segments 1, 2 etc.
(MT): Malaise Trap. This abbreviation is used in brackets under 'Material examined section, to indicate the method of collection.
T1, T2, etc.: Gastral tergites 1, 2 etc.

The following acronyms are used for the depositories:
CAS: California Academy Sciences, San Francisco, California, USA.
QMB: Queensland Museum, Brisbane, Queensland, Australia.
ZDAMU: Insect collections, Department of Zoology, Aligarh Muslim University, Aligarh, India.

Systematics accounts

Genus *Ceranisus* Walker

(Figures 1–27)

Ceranisus Walker, 1842, [Explanation of plates A-P (illustrations of genera of Chalcidoidea by Haliday).] Entomologist 1(26): Plate N, Fig. 2.

Type species *Cirrospilus pacuvius* Walker, by monotypy.

Thripoctenus Crawford, 1911: 233. Type species *Thripoctenus russelli* Crawford, by monotypy. Synonymy by Graham 1959: 203. Stat. Rev., by Doğanlar & Doğanlar, 2013: 457,497. Synonymy by Triapitsyn, 2015: 1.

Epomphale Girault, 1915: 211. Type species *Epomphale auriventris* Girault, by original designation. Synonymy by Bouček 1988: 733. Stat. Rev., by Doğanlar & Doğanlar, 2013: 457, 495. Synonymy by Triapitsyn, 2015: 1.

Urfacus Doganlar, 2003: 182. Type species *Urfacus bozovaensis* Doğanlar, by monotypy and original designation. Synonymy by Doğanlar & Triapitsyn, 2007: 105. Stat. Rev. by Doğanlar & Doğanlar, 2013: 489. Synonymy by Triapitsyn, 2015: 4.

Gaziantepus Doganlar & Doganlar, 2013: 457, 491. Type species *Gaziantepus oguzeliensis* O. Doğanlar, by monotypy and original designation. Synonymy by Triapitsyn, 2015: 1, 4.

Sergueicus Doğanlar & Doğanlar, 2013: 457, 502. Type species *Ceranisus barsoomensis* Triapitsyn, by monotypy and original designation. Synonymy by Triapitsyn, 2015: 1, 4.

Guelsenia Doğanlar & Doğanlar, 2013: 457, 499. Type species *Ceranisus amanosus* Doğanlar, Gumovsky and O. Doğanlar, by original designation. Synonymy by Triapitsyn, 2015: 1, 4.

Diagnosis: ***Female*:** Head dark brown to black. Antenna yellowish brown. Mesosoma dark brown to black; Fore wing subhyaline, venation brown; hind wing largely hyaline. Legs pale yellow to pale brown. Gaster pale yellow to pale brown. Head with occipital suture may be straight, sinulate or angulate; frontal groove reaching eyes on level of anterior ocellus; mandible reduced, without teeth. Antenna (13, 21) with funicle 2-segmented and clava 2- or 3-segmented; last claval segment with a long spicula. Mesosoma usually smooth, mesoscutum anteriorly with incomplete notaular lines; mid lobe of mesoscutum with 4 or 5 setae (except 1 pair in most *C. russelli* (Crawford) (Triapitsyn, 2005). Metasoma with petiole at most broader than long.

***Male*:** Similar to female except sexual dimorphism and clava 3-segmented, last claval segment with long spicula (Figs 19, 26).

Hosts: Endoparasitoid of thrips larvae (Bouček, 1988; Schauff, 1991).

Distribution: Worldwide

Species: World: 40; India: 4

Comments: Taxonomic history of *Ceranisus* was given in detail by Doganlar & Doganlar (2013).

Key to Indian species of *Ceranisus* Walker, females

1. Antennal clava 3-segmented (Fig. 2); mid lobe of mesosctum with 2 setae ....***C. javae* (Girault)**
- Antennal clava 2-segmented; mid lobe of mesosctum with 4 or 5 (at least 3 specimens of *C. menes*) setae 2
2. Fore wing disc either without bare area or a narrow bare area present along posterior margin behind base of marginal vein, it is demarcated anteriorly by a more or less straight cubital line of setae (Fig. 9).....***C. femoratus* (Gahan)**
- Forewing disc with a distinct semi-oval bare area at posterior margin behind base of marginal vein, demarcated anteriorly by a sinuate line of setae (Figs. 16, 23)..... 3
3. F1 a little shorter or subequal to F2 (Fig. 13); postmarginal vein of fore wing shorter than stigmal vein (Fig. 16) .....***C. menes* (Walker)**
- F1 a little longer than F2 (Fig. 21); postmarginal vein of fore wing distinctly longer than stigmal vein (Fig. 23) .....***C. udnamtak* Triapitsyn**

1. *Ceranisus javae* (Girault)

(Figures 1–5)

Epomphale javae Girault, 1917: 1, female. Lectotype, female, Indonesia, Java, Salatiga (USNM), not examined.

Thripoctenus maculatus Waterston, 1930: 243, male, female. Syntype, male, female, Pakistan, Layalpur (BMNH). Synonymy by Husain & Khan, 1986: 212.

Thripobius semiluteus Bouček, 1976: 412, female. Holotype, female, Africa, Sao

Tomé (BMNH). Synonymy by Triapitsyn, 2005: 310.

Ceranisus maculatus (Waterston): Loomans & van Lenteren, 1995: 128, diagnosis, biology.

Thripobius semiluteus Bouček: Bouček, 1988: 734, diagnosis, record. Loomans & van Lenteren, 1995: 132–137, diagnosis, biology.

Ceranisus javae (Girault): Loomans & van Lenteren, 1995: 132, diagnosis.

Thripobius javae (Girault): Triapitsyn, 2005: 310.

Redescription:

***Female*:** Length, 0.56–0.59 mm. Head brown with reddish reflection, eye reddish. Antenna with scape pale yellow, pedicel and flagellum pale yellow with brownish tinge. Mesosoma brown except pronotum dark brown. Wings hyaline and setose apically. Legs, including coxae pale white to pale yellow. Gaster pale yellow.

Head (Fig. 1) in frontal view, 1.41–1.6× as broad as high; eye height 2.10–2.66× as long as malar space. Antenna (Fig. 2) with scape 5.14–6.33× as long as broad, 2–2.11× as long as pedicel; pedicel 2–2.25× as long as broad; F1 almost rectangular, longer than F2 with one sensillum; clava 3-segmented, 2.28–3.16× as long as broad.

Mesosoma (Fig. 3) almost smooth; pronotum narrow, hardly visible in dorsal view; mesoscutum subequal to scutellum; notauli incomplete, distinct anteriorly; mid lobe of mesoscutum medially with a pair of setae; scutellum sub-rectangular with 1+1 setae near latero-posterior angle; each side lobe of mesoscutum and axilla with one seta. Fore wing (Fig. 4) 2.83–3× as long as broad; marginal vein+parastigma 1.34–1.52× as long as submarginal vein; disc setose; longest marginal seta 0.53–0.63× maximum wing width. Hind wing (Fig. 5) 10.25–10.5× as long as broad; longest marginal seta 2–2.25× as long as maximum wing width.

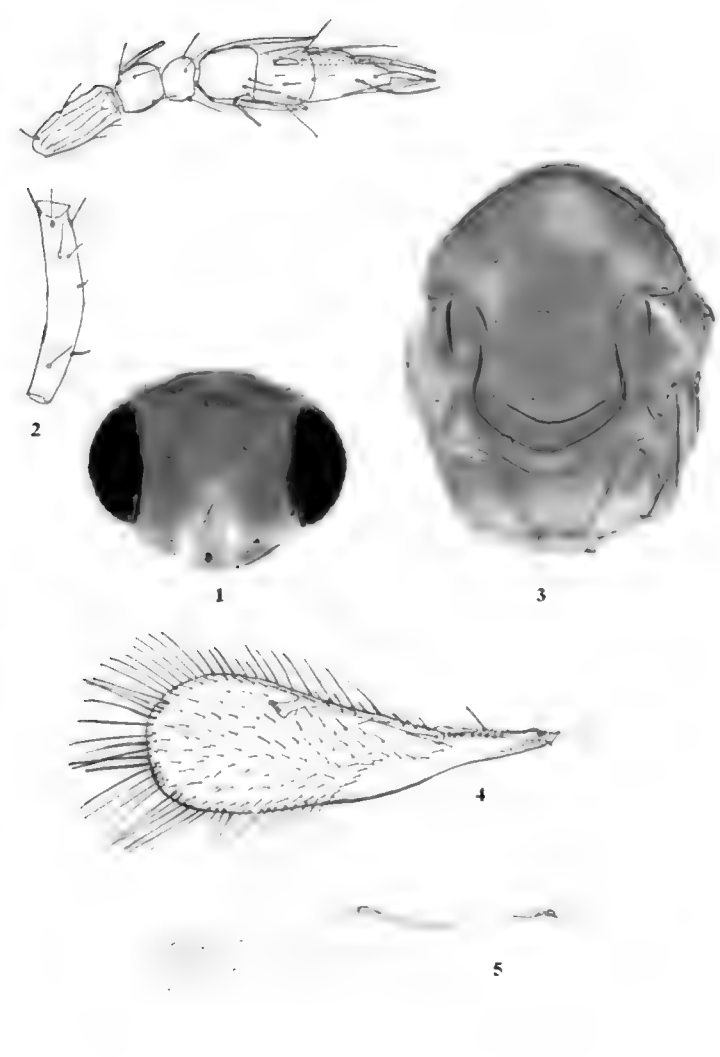
Metasoma shorter than mesosoma; petiole 3× as broad as long; ovipositor not exserted beyond apex of gaster and 0.66–0.84× as long as hind tibia.

Relative measurements (n=3): Head height: width, 12–12.5: 17–20; eye height, 8–9; malar space, 3–4.5. Antennal segments—length: width; scape, 9–9.5: 1.5–1.75; pedicel, 4.5: 2–2.25; F1, 1.75–2.25: 2; F2, 1.25–1.5: 2–2.5; C1, 2.25–3: 3–3.5; C2, 2.5: 3–3.5. Mesosoma length, 21–24. Forewing length: width, 41–46: 15–16; marginal vein length, 13.5–16; submarginal vein length, 11.5–12.5; parastigma length, 2–3; post marginal vein length, 1–1.5; stigmal vein length, 2–3; longest marginal seta, 8–9.5. Hind wing length: width, 41–42: 4; longest marginal seta, 8–9. Hind tibia length, 13–15. Metasoma- Petiole length: width, 1–3; gaster length, 17–19; ovipositor, 10–11.

***Male*:** Unknown.

Material examined: INDIA: UTTARAKHAND: Dehradun, Sahaspur, 3 females (on slide, slide. Nos. EUL.102 and EUL.103, EUL.125), 19.iii.2016, Coll. M.M. Jamali & P.T. Anwar (ZDAMU).

Distribution: India: Karnataka, Punjab & Uttarakhand (**new record**).



Figures 1–5. *Ceranisus javae* (Girault) Female: **1.** head, frontal view; **2.** antenna; **3.** mesosoma; **4.** fore wing; **5.** hind wing.

Comments: *Ceranisus javae* (Girault) comes close to *C. russelli* (Crawford) in having 3-segmented clava, but differs in following characters: antenna with F1 distinctly longer than F2; fore wing with submarginal vein shorter than marginal vein; postmarginal vein

shorter than stigmal vein. In *C. russelli* antenna with F1 subequal or shorter than F2; fore wing with submarginal vein longer than marginal vein; postmarginal vein longer than stigmal vein.

2. *Ceranisus femoratus* (Gahan)

(Figures 6–11)

Thripoctenus femoratus Gahan, 1932: 747, female. Holotype, female, Philippines, Luzon, Laguna (USNM), not examined.

Ceranisus femoratus (Gahan): Baltazar, 1966: 112. Loomans & van Lenteren, 1995: 130, 196, diagnosis; 196, synonymy. Triapitsyn, 2005: 299, diagnosis; 300, illustration.

Redescription:

***Female*:** Length, 0.78 mm. Head dark brown to black. Antenna with scape and pedicel brown, flagellum pale brown; mesosoma dark brown to black. Fore wing subhyaline; hind wing largely hyaline. Legs with coxae and femora brown to dark brown except trochanter of mid leg pale white, tibiae pale brown, tarsi pale white. Gaster brown.

Head (Fig. 6) in frontal view, 1.44× as broad as high. Antennal (Fig. 7) scape 4.2× as long as broad, 2.2× as long as pedicel; pedicel 1.9× as long as broad; funicle 2-segmented; F1 subequal to F2, both with one placoid sensilla; clava 2-segmented, 1.5× as long as broad.

Mesosoma (Fig. 8) almost smooth; pronotum narrow, visible in dorsal view; mesoscutum slightly shorter than scutellum; notauli incomplete; mid lobe of mesoscutum with 4 setae; each side lobe at posterior angle with 1 seta; scutellum slightly broader than long with 1 seta at each lateral margins. Fore wing (Fig. 9) 2.3× as long as broad; marginal vein+ parastigma 1.6× as long as submarginal vein, 7.8× as long as stigmal vein; post marginal vein 1.3× as long as stigmal vein; longest marginal seta 0.23× maximum wing width. Hind wing (Fig. 10) 6.5× as long as broad; longest marginal seta 0.81× as long as maximum wing width.

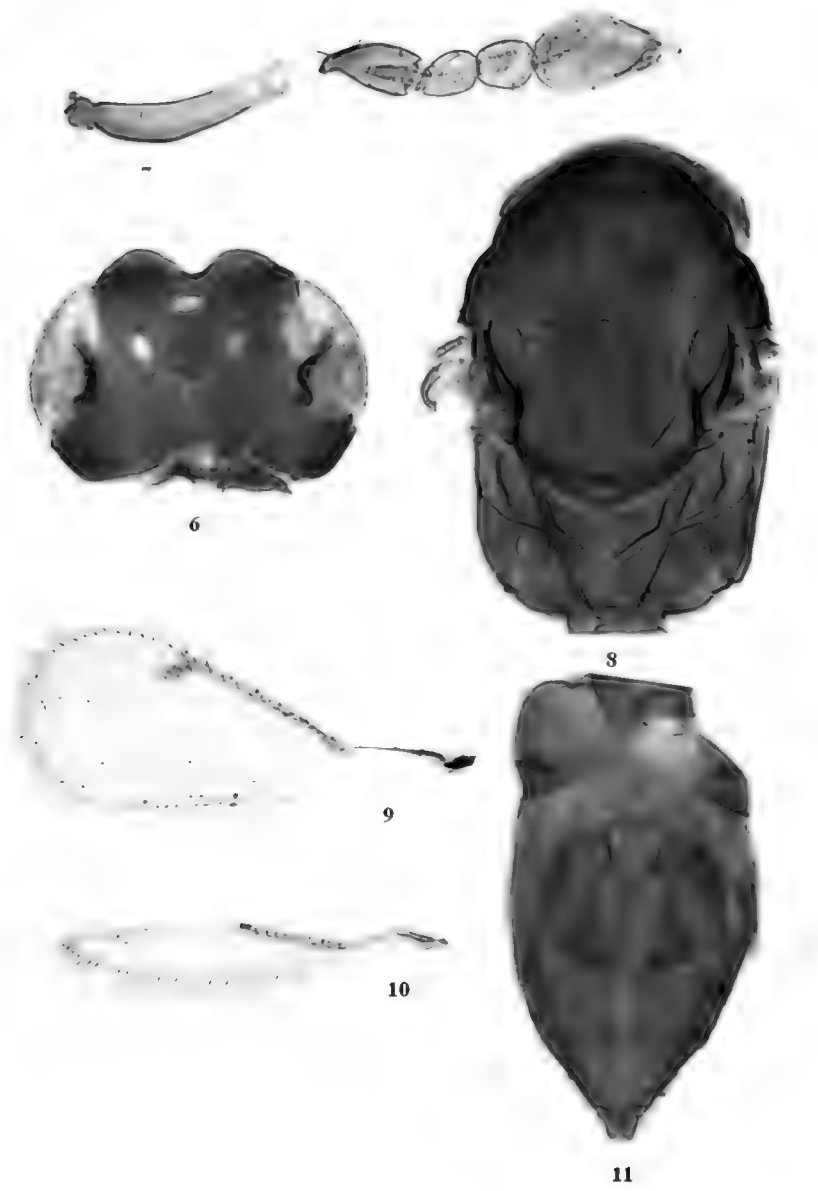
Metasoma (Fig. 11) longer than mesosoma; petiole 1.7× as broad as long; ovipositor occupying three-fourth of gaster length, slightly exserted beyond the apex of gaster; ovipositor 1.87× as long as hind tibia.

Relative measurements: Head height: width, 18: 26. Antennal segments–length: width; scape, 10.5: 2.5; pedicel, 4.75: 2.5; F1, 3: 2.25; F2, 3: 2.5; clava, 6.75: 4.5. Mesosoma length, 32. Fore wing length: width, 56: 24; submarginal vein length, 14; parastigma length, 2; marginal vein length, 21.5; post marginal vein length, 4; stigmal vein length, 3; longest marginal seta, 5.75. Hind wing length: width, 52: 8; longest marginal seta, 6.5. Hind tibia length, 16. Metasoma- Petiole length: width, 2.5: 4.25; gaster length, 35; ovipositor, 30.

***Male*:** Unknown.

Material examined: INDIA: ANDHRA PRADESH: Vishakhapatnam, Rajipeta, 1 female (on slide under four coverslips, slide No. EUL.211), 3.ii.2014, Coll. M.T. Khan. (ZDAMU).

Distribution: India: Andhra Pradesh.



Figures 6–11. *Ceranisus femoratus* (Gahan) Female: **6.** head, frontal view; **7.** antenna; **8.** mesosoma; **9.** fore wing; **10.** hind wing; **11.** metasoma.

Comments: The redescription of the species is based on material collected from Indian state of Andhra Pradesh agreeing fairly well with the redescription given by Triapitsyn (2005). However *C. femoratus* comes close to *C.*

votetoda Triapitsyn (2005), but differs in following characters: antenna with funicle segment F1 subequal to F2, each with one sensillum; mesosoma with moderate pronotum; fore wing with longest marginal setae almost one-fourth maximum wing width; hind wing 6.5× as long as broad; longest marginal seta distinctly shorter than maximum wing width. In *C. votetoda*: antenna with funicle segment F1 distinctly shorter than F2 and F1 and F2 without sensillum; mesosoma with a long pronotum; fore wing with longest marginal setae almost one-tenth maximum wing width; hind wing 8× as long as broad; longest marginal seta equal to maximum wing width.

3. *Ceranisus menes* (Walker)

(Figures 12–20)

Pteroptrix menes Walker, 1839: 18, female. Lectotype, female, England, London (BMNH), not examined.

Thripoctenus brui Vuillet, 1914: 553, female. Paratype, female, France (USNM). Synonymy by Bouček, 1961: 26.

Thripoctenus vinctus Gahan, 1932: 746, female. Holotype, female, Philippine, Luzon, Laguna (USNM). Synonymy by Triapitsyn, 2005: 293.

Ceranisus rosilloi De Santis, 1961: 13, female. Holotype, female, Argentina (MLP). Synonymy by De Santis & Fidalgo, 1994: 89.

Euderomphale menes (Walker): Erdös, 1956: 25.

Ceranisus menes (Walker): Graham, 1959: 203. Bouček, 1961: 26, record. Graham, 1963: 203, catalogue. Bouček & Askew, 1968: 137, record. Trjapitzin, 1978: 426, record. Bouček, 1988: 734, synonymy, diagnosis. Loomans & van Lenteren, 1995: 99–115, synonymy, diagnosis. Triapitsyn & Headrick, 1995: 233–235, redescription of male and female, host associations, figures. Lacasa, Sánchez & Lorca, 1996: 341–346, 348. Roditakis & Roditakis, 2002: 154, biology. Triapitsyn & Morse, 2005: 72, review. Thangjam *et al*., 2013: 30, record.

Ceranisus vinctus (Gahan): Baltazar, 1966: 112, catalogue. Loomans & van Lenteren, 1995: 125–127, diagnosis, biology. Bouček & Askew, 1968: 138, synonymy.

Ceranisus brui (Vuillet): Yoshimoto, 1965: 690, record. Murai, 1988: 1–73, biology.

Epomphale menes (Walker): Doğanlar & Doğanlar, 2013: 497.

Redescription:

***Female*:** Length, 0.5–0.85 mm. Head dark brown to black. Antenna pale brown; mesosoma dark brown to black. Fore wing hyaline, venation brown; hind wing largely hyaline. Legs largely pale yellow except coxae in basal half brown. Gaster pale yellow to pale brown.

Head (Fig. 12) broader than mesosoma, in frontal view, 1.23–1.57× as broad as high. Antennal toruli situated below the lower eye margin. Antenna (Fig. 13) with scape 4.4–5× as long as broad, 1.9–2.27× as long as pedicel; pedicel 1.66–2.2× as long as broad; funicle segments slightly longer than broad; F1 subequal or slightly longer than F2; F1 with or without sensillum, F2 with one sensillum; clava 2-segmented, 2.12–3× as long as broad, distinctly longer than funicle, with longitudinal sensilla.

Mesosoma (Figs. 14, 15) 1.18–1.5× as long as broad; pronotum with a pair of thick setae; mesoscutum subequal to scutellum with linolate sculpture; mid lobe of mesoscutum with 4–5 setae; scutellum with 1 setae present in middle near each lateral margins. Fore wing (Fig. 16) 2.5–2.75× as long as broad; marginal vein+parastigma 1.6–1.9× as long as submarginal vein, 5.25–6.42× as long as stigmal vein; post marginal vein short, 0.25–0.5× stigmal vein; longest marginal seta 0.28–0.44× maximum wing width. Hind wing (Fig. 17) 7.6–9× as long as broad; longest marginal seta 1.3–1.5× as long as maximum wing width.

Metasoma distinctly longer than mesosoma; petiole 2–4× as broad as long; ovipositor (Fig. 18) occupying more than two-third length of gaster, slightly exserted beyond apex of gaster; ovipositor 1.2–1.6× as long as hind tibia.

Relative measurements (n=5): Head height: width, 14–21: 22–26. Antennal segments–length: width; scape, 10–12.5: 2–2.5; pedicel, 5–6: 2.5–3; F1, 3–3.5: 2.5; F2, 2.5–3.5: 2.5–3; C1, 3–4.5: 3.5–4.5; C2, 5.5–7.5: 4. Mesosoma length, 26–33: 20– 22. Fore wing length: width, 47–64: 17–25; submarginal vein length, 11–15.5; parastigma length, 1.5–2; marginal vein length, 19–26; post marginal vein length,

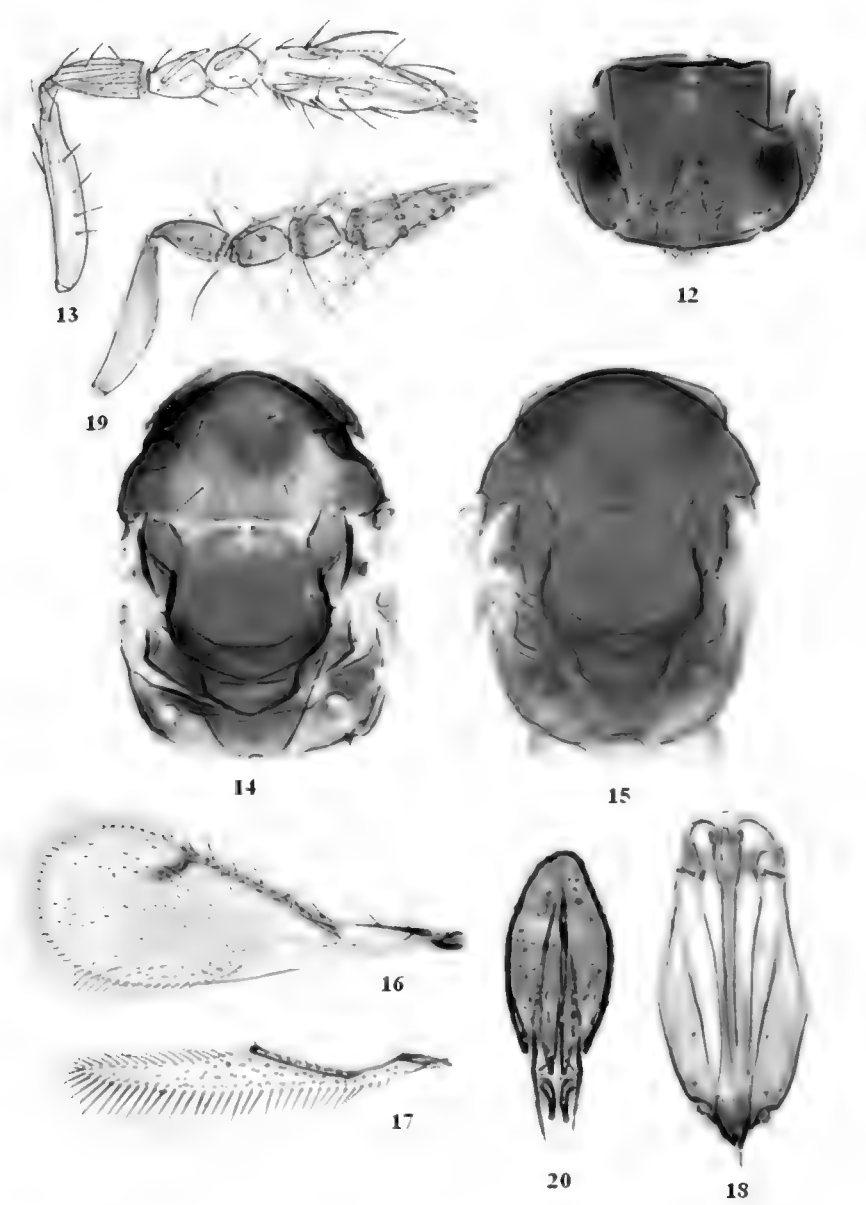
1–2; stigmal vein length, 3.5–4.5; longest marginal seta, 6.5–9.5. Hind wing length: width, 43–61: 5.5–8; longest marginal seta, 8–11.5. Hind tibia length, 14–20. Metasoma-Gaster length, 33–41; ovipositor, 21–24.

Male: Length, 0.56–0.7 mm, similar in colour to female except sexually dimorphic features. Antennal (Fig. 19) flagellum with long hairs and clava 3-segmented. Genitalia as in figure 20.

Material examined: INDIA: ANDHRA PRADESH: East Godawri, Kokinoda, Thimmapuram, 3 females (on slides, slide Nos. EUL.52, EUL.53 and EUL.54), 7.ii.2014, Coll. M.T. Khan; Guntur, Kulnukonda, 4 females (on slides, slide Nos. EUL.2, EUL.34, EUL.35 and EUL.51), 11.ii.2014, Coll. M.T. Khan; Vishakhapatnam, Rajipeta, 1 male, 3.ii.2014, Coll. M.T. Khan. SIKKIM: Tadong, ICAR campus, 2 males (on cards) 1.xii.2014 (MT), Coll. K. Veenakumari. UTTAR PRADESH: Etah, Patna Pakshihi Vihar (Bird Sanct.), 2 females, 1 male (on slides, slide Nos. EUL.45, EUL.47 and EUL.126), 27.xi.2011, Coll. S.B. Zeya, P.T. Anwar and S.U. Usman. UTTARAKHAND: Roorkee, Delda, 1 female (on slide, slide No. EUL.1), 2.xi.2009, Coll. F.R. Khan; Dehradun, Sahaspur, 2 females (on slides, slide Nos. EUL.116 and EUL.40), 19.iii.2016, Coll. M.M. Jamali and P.T. Anwar (ZDAMU).

Distribution: India: Andhra Pradesh (**new record**), Karnataka, Sikkim (**new record**), Tamil Nadu, Uttar Pradesh, Uttarakhand.

Comments: The redescription of the species is based on the specimens collected from several Indian states, agreeing fairly well with the redescription given by Triapitsyn and Headrick (1995) and Thangjam *et al*. (2013). It is to note that all the described species under the genus contain 4 setae on midlobe of mesoscutum but in 3 Indian specimens collected from Andhra Pradesh are with 5 setae. However, it superficially resembles *C. udnamtak* Triapitsyn (2005), but it differs by the characters given under the comments of *C. udnamtak.*



Figures 12–20. *Ceranisus menes* (Walker) (12–18) female: **12.** head, frontal view; **13.** antenna; **14.** mesosoma, showing mid lobe of mesoscutum with 4 setae; **15.** mesosoma, showing mid lobe of mesoscutum with 5 setae; **16.** fore wing; **17.** hind wing; **18.** ovipositor. (19–20) male: **19**. antenna; **20.** genitalia.

4. *Ceranisus udnamtak* Triapitsyn

(Figures 21–27)

Ceranisus udnamtak Triapitsyn, 2005, Female. Holotype, female, Nepal, Katmandu (CAS), not examined.

Redescription:

***Female*:** Length, 0.72–0.75 mm. Head metallic dark brown. Antenna with scape pale white; pedicel and flagellum pale brown. Mesosoma metallic dark brown; area around notaular lines and axillae with greenish reflection. Fore wing hyaline. Hind wing largely hyaline. Legs with coxae pale white except hind coxa in basal half brown and tarsi of all legs pale brown. Gaster with T1 and T2 pale white, the remainder pale brown.

Head in frontal view, 1.14–1.25× as broad as high; eye height 2.50–2.63× as long as malar space. Antennal toruli situated at the level of lower eye margin. Antenna (Fig. 21) with scape 5–5.4× as long as broad and 2.5–2.7× as long as pedicel; pedicel 1.67–2× as long as

broad, subequal to F1; F1 slightly longer than F2, each funicle segment with one sensillum; clava 2-segmented, 2.17–2.25× as long as broad.

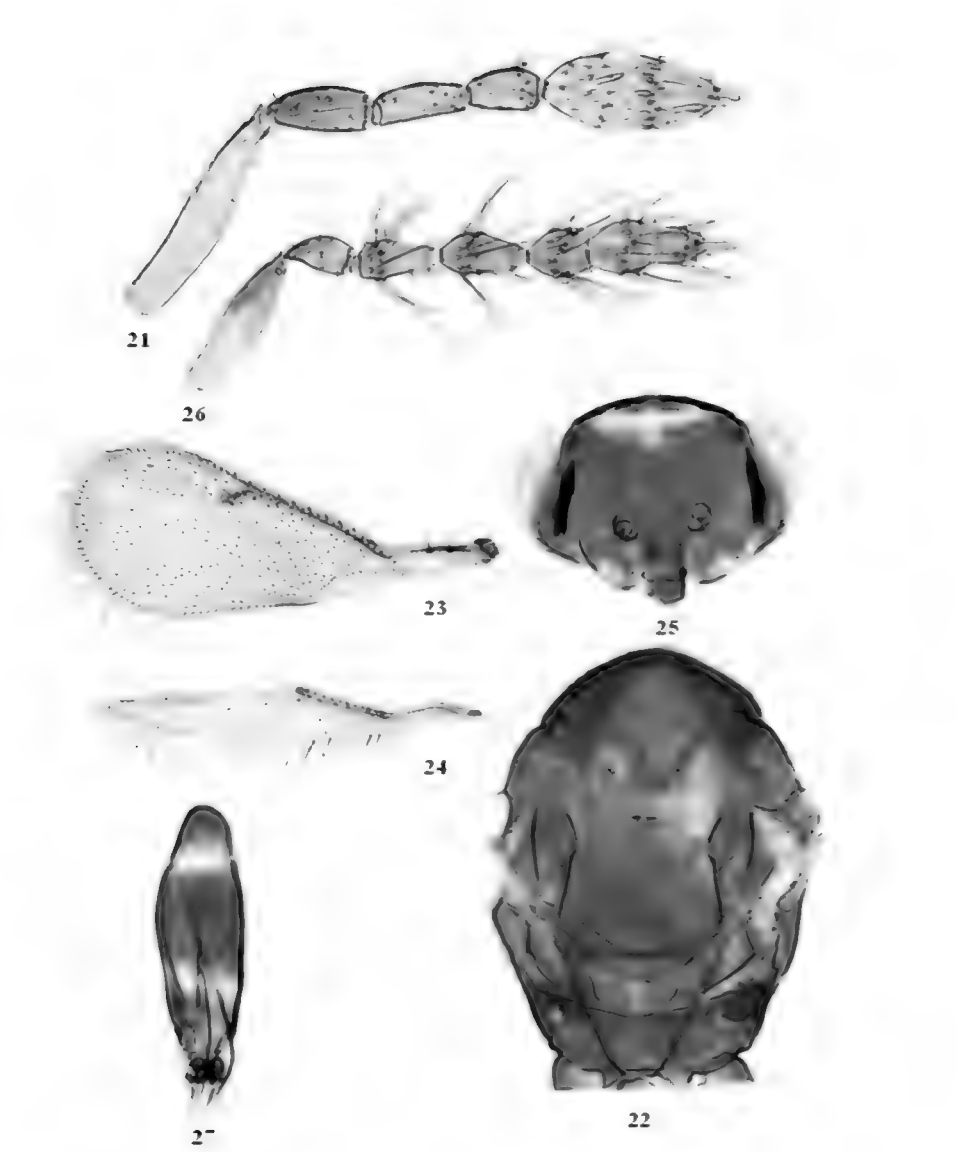
Mesosoma (Fig. 22) Pronotum smooth, narrow with 4–7 small setae and 2 long setae. Mesoscutum subequal to scutellum, mid lobe of mesoscutum with 2 pairs of setae; each side lobe of mesoscutum with 2 setae; each axilla with one seta; scutellum subquadrate with 1+1 setae near the lateral margins. Fore wing (Fig. 23) 2.32–2.42× as long as broad; marginal vein+parastigma 1.62–1.73× as long as submarginal vein, 5.7–6.5× as long as stigmal vein; post marginal vein very long, 2.11–2.37× as long as stigmal vein; disc more or less uniformly setose; longest marginal seta 0.19–0.22× maximum wing width. Hind wing (Fig. 24) 6.78–7.23× as long as broad; longest marginal seta 1.05–1.12× as long as maximum wing width.

Metasoma slightly longer than mesosoma; petiole 3.2–4× as broad as long; ovipositor not exserted beyond apex of gaster and 1.30–1.34× as long as hind tibia.

Relative measurements (n=3): Head height: width, 20–24: 24–30; eye height, 14.5–15; malar space, 5.5–6. Antennal segments—length: width; scape, 12–13.5: 2.25–2.5; pedicel, 4.75–5: 2.5–3; F1, 4–4.5: 2; F2, 3.5–4: 2–2.5; C1, 3.5–4: 4–4.5; C2, 5.5–6: 4–4.5. Mesosoma length, 32–37. Forewing length: width, 66–72: 28–31; marginal vein length, 23–26; submarginal vein length, 15.5–17; parastigma length, 2–3.5; post marginal vein length, 9.5–10; stigmal vein length, 4.5; longest marginal seta, 5.5–7. Hind wing length: width, 61–65: 9; longest marginal seta, 9.5–10. Hind tibia length, 21–23. Metasoma- Petiole length: width, 1–1.5: 4; gaster length, 31–41; ovipositor, 28–30.

Male*: *Head (Fig. 25) in frontal view, 1.5× as broad as high; eye height 2× as long as malar space. Antennal toruli situated slightly above the lower eye margin. Antenna (Fig. 26) with scape 3.46× as long as broad, 2.6× as long as pedicel; pedicel 1.6× as long as broad, shorter than F1 and F2 individually; F1 subequal to F2; clava 3-segmented, 3.3× as long as broad.

Mesosoma almost smooth, similar to female. Fore wing 2.28× as long as broad; marginal vein+parastigma 1.7× as long submarginal vein, 5.7–6.5× as long as stigma vein; post



Figures 21–27. *Ceranisus udnamtak* Triapitsyn (21–24) female: **21.** antenna; **22.** mesosoma; **23.** fore wing; **24.** hind wing. (25–27) male: **25.** head, frontal view; **26.** antenna; **27.** genitalia.

marginal vein 2.3× as long as stigmal vein; longest marginal seta 0.23× maximum wing width. Hind wing 6.84× as long as broad; longest marginal seta subequal to maximum wing width.

Metasoma slightly longer than mesosoma; petiole 2× as broad as long. Genitalia as in figure 27.

Relative measurements: Head height: width, 19: 29; eye height, 13; malar space, 6. Antennal segments length: width; scape, 13: 3.75; pedicel, 5: 3; F1, 6.5: 3.25; F2, 6.75: 3.5; C1, 5: 4; C2, 5: 4.5; C3, 4.5: 3.25. Mesosoma length, 41. Forewing length: width, 73: 32; marginal vein length, 26; submarginal vein length, 17; parastigma length, 3; stigmal vein length, 4.5; post marginal vein length, 10.5; longest marginal seta, 7.5. Hind wing length: width, 65: 9.5; longest marginal seta, 9. Hind tibia length, 23. Metasoma- Petiole length: width, 2.5: 5; gaster length, 46.

Material examined: INDIA: UTTARAKHAND: Sahaspur, Kaichiwala, 3 females, 1 male (on slides, slide Nos. EUL.119, EUL.122 and EUL.123, EUL.228),

19.iii.2016, Coll. M. M. Jamali & P.T. Anwar (ZDAMU).

Distribution: India: Uttarakhand (**new record**); Nepal.

Comments: The redescription of *Ceranisus udnamtak* Triapitsyn is based on the specimens collected from Indian state of Uttarakhand, agreeing fairly well with the original description of *C. udnamtak* given by Triapitsyn (2005). However, it slightly differs from the holotype (characters of holotype, *C. udnamtak* are in parentheses): fore wing 2.32–2.42× as long as broad (fore wing 2.53× as long as broad); longest marginal seta 0.19–0.22× maximum wing width (longest marginal seta 0.25× maximum wing width); pedicel 0.37–0.40× scape length (pedicel 0.43× scape length); ovipositor 1.30–1.34× as long as hind tibia (ovipositor 1.2× as long as hind tibia.). I consider these minor differences fall within the range of variation for the species.

Further it differs from *C. menes* (Walker) in following characters: pedicel subequal or slightly longer than F1; funicle segments distinctly longer than broad; F1 distinctly longer than F2; fore wing with post marginal vein very long, 2.11–2.37× as long as stigmal vein; longest marginal seta 0.19–0.22× maximum wing width. In *C. menes* funicle segments slightly longer than broad; F1 subequal or slightly longer than F2; fore wing with post marginal relatively very short, 0.33× stigmal vein; longest marginal seta 0.35× maximum wing width.

Acknowledgement

We thank the Chairman, Department of Zoology, Aligarh Muslim University, Aligarh, for providing research facilities. We also thank Dr. Mohammad Hayat, Department of Zoology, Aligarh Muslim University, Aligarh, for constant help and encouragements.

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ISSN 0973-1555(Print) ISSN 2348-7372(Online)
HALTERES, Volume 10, 96-99, 2019
doi: 10.5281/zenodo.3596066

Polysphincta idukkiensis (Hymenoptera: Ichneumonidae: Pimplinae) a rare new species from the southern Western Ghats

***Manjusha B.M.[1], Sudheer K.[2] & Ghosh S.M.[3]**

[1] *Research Scholar, Department of Zoology, Government College Kasaragod, Vidyanagar, Kerala, India.*
[2] *Assistant Professor in Zoology, Prof. T.C. Narendran Biodiversity Research Lab., The Zamorin's Guruvayurappan College, Kozhikode, Kerala, India.*
[3] *Department of Molecular Biology, Kannur University, Kerala, India.*

(Email: manjushabm@gmail.com)

Abstract

The members of the genus *Polysphincta* are koinobiont parasitoids exclusively associated with free living spiders. The genus is currently represented by three valid species from the Oriental region, viz., *Polysphincta boops* Tschek, 1869, *P. longa* Kasparyan, 1976 and *P. punctigaster* Varga & Reshchikov, 2015. In the present paper *Polysphincta idukkiensis* sp.n. is described from the Pambadum shola forests of Idukki district, a part of the southern Western Ghats of India. The species is closely related to *P. boops* Tschek in having impunctate swelling on metasomal tergites, but it differs from *P. boops* Tschek in having shallow close punctures on propodeum, and also on the length of ovipositor sheath. A key to the Oriental species of *Polysphincta* Gravenhorst, 1829 is provided.

Keywords: *Polysphincta, Key, India, new species, new record, Ichneumonidae.*

Received: 28 October 2019; Revised: 31 December 2019; Online: 31 December 2019

Introduction

The genus *Polysphincta* was erected by Gravenhorst in 1829 with the type species *Polysphincta tuberosa*. *Polysphincta* is a relatively small genus of the tribe Ephialtini under the subfamily Pimplinae of family Ichneumonidae and is represented by 28 described species (Yu *et al*., 2012; Varga & Reshchikov, 2015). They are koinobiont parasitoids exclusively associated with free living spiders. The genus is currently represented by three valid species from the Oriental region, viz., *Polysphincta boops* Tschek, *P. longa* Kasparyan and *P. punctigaster* Varga & Reshchikov. Varga and Reshchikov (2015) synonymized *P. asiatica* Kusigemati, 1984 to *P. boops* Tschek. All the known species are strictly associated with species of the family Araneidae (Fitton *et al*., 1988; Yu *et al*., 2012).

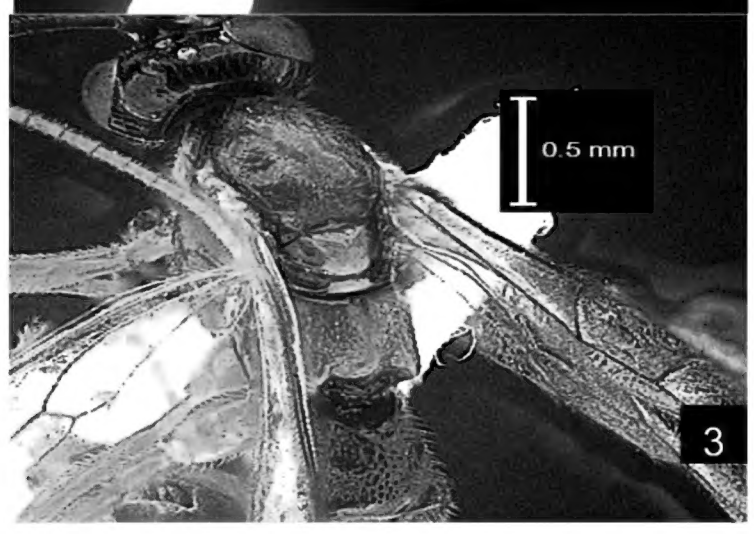
Many of them have multiple host species, with the exception of *P. longa*, which has only one host species (Fitton *et al*., 1988; Schmitt *et al*., 2012; Yu *et al*., 2012; Fritzen and Shaw 2014; Korenko *et al*., 2014). In the present paper, a new species of *Polysphincta* viz., *P. idukkiensis* **sp.n.,** is described from the Pambadum shola forests of Idukki district, a part of the southern Western Ghats.

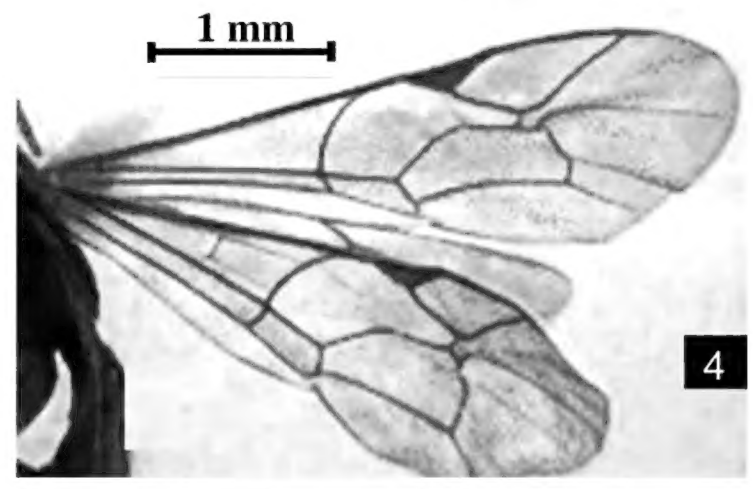
Materials and Methods

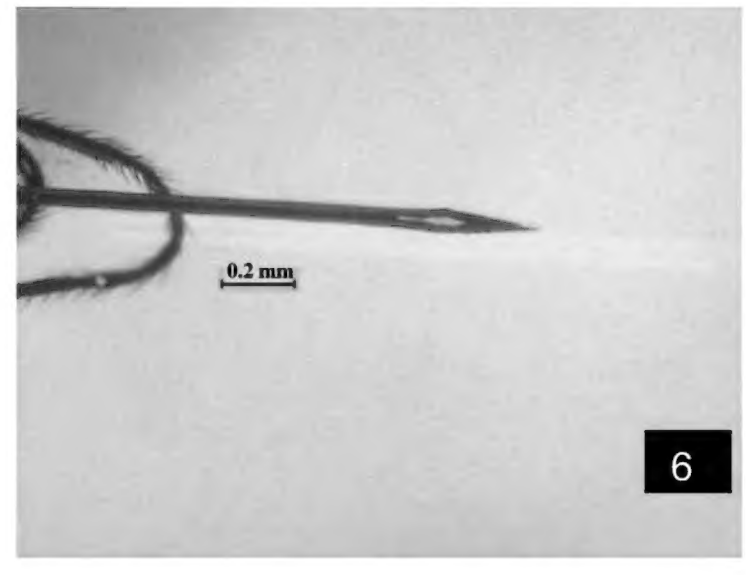
The current study is based on material collected from the Pambadum shola forests. Morphological terminology used in the study follows that of Townes (1969) and of Wahl and Sharkley (1993). Images were taken using Leica Stereomicroscope model no: M205 A.

Abbreviations used:
FWL- Fore Wing Length
FWW- Fore Wing Width
HWL- Hind Wing Length
HWW- Hind Wing Width
T- Tergites (T1-T8)
WGRC: Western Ghats Regional Centre of the Zoological Survey of India, Kozhikode, Kerala

The type specimen is currently deposited in the Prof. T.C. Narendran Biodiversity Research Laboratory (NBRL), University of Calicut, Kozhikode and will be transferred to the WGRC, ZSI, Kozhikode.







Figures 1-6. *Polysphincta idukkiensis* **sp.n.**: **1.** Lateral view of habitus; **2.** Front view of head; **3.** Dorsal view of mesoscutum and propodeum; **4.** Wings; **5.** Dorsal view of metasoma; **6.** Lateral view of ovipositor

Taxonomy

Genus *Polysphincta* Gravenhorst, 1829

Diagnosis: Upper tooth of mandibles longer than lower tooth. Clypeus tansverse, apically centrally truncate. Head more or less evenly rounded. Mesoscutum convex, from densely pubescent to smooth and glabrous. Mesopleuron with prepectal carina present. Propodeum moderately long, usually without carinae. Fore wing with areolet open, second intercubitus absent, nervulus opposite to basal vein. Hind wing with discoidella present. Metasoma with tergite 1 slightly elongate, all four tergites shining with punctures between antero lateral swellings. Ovipositor straight or slightly sinous, projecting beyond the apex of metasoma.

***Polysphincta idukkiensis* Manjusha, Sudheer & Ghosh sp.n.** (Fig.1-6)

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Description: Female: body length= 7.2 mm (Including ovipositor)

Head: In dorsal view HL= 1.45 mm and HW = 0.56 mm; in front view HL= 1.7 mm and HW= 1.5 mm; face with sparse punctures,

hairy, interstices smooth and shiny; clypeus apically truncate, with long hairs; mandible with upper tooth longer than lower, hairs smaller than in face, 0.45x high as wide; malar space polished, 0.7x the basal width of mandible; vertex convex, polished, impunctate, with small few hairs; occipital carina complete; temple and gena impunctate with small hairs; diameter of lateral ocellus 0.75x long as ocellar ocular distance; inter-ocellar distance 0.67x ocello ocular distance, 0.76x distance between median and lateral ocelli; antenna with 27 segments, scape 1.44x as long as width, 1.5x as long as pedicel, pedicel 0.21x as long as first flagellar segment, first flagellar segment 1.45x as long as second flagellar segment, 5x as long as last flagellar segment, second flagellar segment equal to the length of third flagellar segment.

Mesosoma: 1.7x long as head length in dorsal view, 0.9x as long as width between tegulae; pronotum polished, epomia present, almost reaching upper margin of pronotum; mesoscutum impunctate, few hairs on anterio-lateral and posterior side; notauli distinct on anterior 0.2 of mesoscutum; scutellum convex, impunctate, with sparse hairs; mesopleurum polished, impunctate, few hairs on upper anterior and middle, speculum smooth and shiny, lower region with more hairs than anterior upper; prepectal carina present on lower 0.5 of mesopleurum; metapleurum impunctate, polished with sparse hairs; submetapleural carina complete and strong; propodeum with shallow close punctures, posteriorly with declivities without carina, hairs present; propodeal spiracle elongate; legs slender; FWL= 3.28 mm, FWW= 1.72 mm, HWL= 2.08 mm, HWW= 1.51 mm; areolet open; second intercubitus absent, nervulus opposite to basal vein, intercepted below 0.12; nervellus complete; discoidella present.

Metasoma: T1 1.4x as long as apical width, 1.2x length of T2, T1 with deep coarse punctures, hairs on lateral side, ventro-lateral carina present, apical area smooth and shiny; T2–T7 a pair of swelling without punctures, smooth and shiny, with apical area smooth and shiny, remaining area with coarsely punctures; T8 with small minute punctures, smooth and shiny with hairs; legs slender, hind leg with femur 4x long as wide, 0.74x long as hind tibia, first tarsomere 2.8x long as second, 5.1x long as third tarsomere, 7.75x long as fourth tarsomere, 3.87x long as fifth tarsomere and third tarsomere 0.75x long as fifth tarsomere; ovipositor straight, upper valve basally broadened, lower valve extending beyond upper valve, tip of lower valve with oblique ridges; ovipositor length 2.2 mm; ovipositor sheath 1.45x hind tibia, densely pubescent.

Colour: Head and face black except antennal base and lateral side of scape yellow, and brownish black clypeus; mesoscutum reddish brown, scutellum yellowish white, brownish-yellow anteriorly, post-scutellum whitish-yellow, pronotum black, mesopleurum and metapleurum reddish brown; propodeum reddish brown; first tergite black, T2–T6 reddish brown, apices of T2, T3 black, T7 and T8 black; all coxae whitish yellow; hind tibia with sub basal and apical brown bands; tarsi brownish yellow at their apices, ovipositor reddish brown with sheath black.

Male: Unknown; **Host**: Unknown

Material examined: Holotype: ♀, INDIA: KERALA, Idukki, Pambadumshola (N 10°07'34"- E 77°14'58"), Sweep net, 8.iv.2016, Coll. Bijoy, Reg No: NBRL/PIM/19232.

Etymology: The species is named after the type locality, Idukki a district of Kerala.

A key to the Oriental species of the genus *Polysphincta* Gravenhorst

1. Ovipositor sheath 1.45x long as hind tibia; propodeum with shallow close punctures……..……***P. idukkiensis*** **sp.n.**
- Ovipositor sheath < 1.4x long as hind tibia; propodeum usually impunctate, if punctures present sparse……..**2**
2. Tergites 3-6 with two anterolateral swellings densely punctate, anteriorly and between swellings sparsely punctate…… .....***P. punctigaster*** **Varga & Reschikov**
- Tergites 3-6 with two anterolateral swellings impunctate, anteriorly and between swellings indistinctly granulate with small punctures……**3**
3. Central lobe of mesoscutum shorter and rounded, mesoscutum highly pubescent; propodeum impunctate…….. ……***P. longa*** **Kasparayan**
- Central lobe of mesoscutum elongate and flat, mesoscutum sparsely pubescent; propodeum sparsely punctate…….... ……***P. boops*** **Tschek**

Discussion

Polysphincta idukkiensis **sp.n.** shows following variations with *P. boops*. In *P. idukkiensis* **sp.n.,** ovipositor sheath 1.45x long as hind tibia whereas in *P. boops,* it is 1.1-1.4x long as hind tibia. Propodeum of *P.idukkiensis* **sp.n.** has close shallow punctures and virtually bare in posterior declivities but in *P.boops* propodeum weakly and very sparcely punctate on anterior half, virtually bare on posterior half. In *P. idukkiensis* **sp.n.,** nervellus is intercepted at lower 0.12 and in *P. boops* nervellus is intercepted at lower 0.37-0.5. Hind femur stouter, 4x long as wide in lateral view in *P.idukkiensis* **sp.n**. (In *P.boops,* hind femur slender, 5.3- 5.9 x long as wide).

The new species is also similar to *P. longa* Kasparyan in having mesoscutum without dense hairs on posterior region of median lobe, but differs in having propodeum with close shallow punctures and impunctate swellings on T1-T7. *Polysphincta idukkiensis* **sp.n.** differs from *P. punctigaster* in having impuncate swelling on T2-T7, (In *P. punctigaster* punctate swelling on T3-T6).

Acknowledgements

The first author is thankful to the University of Kannur for the Research assistance. She is also grateful to Bijoy for the collection of the specimen and to Ranjith A.P, Research Scholar Calicut University for his support and timely help. The authors also acknowledge the Department of Zoology, Government College Kasaragod, Kannur University, and the Department of Zoology, Zamorin's Guruvayurappan College, for providing necessary laboratory facilities.

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